Institute for Water Resources

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Planning Manual Part II: Risk-Informed Planning

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Risk-Informed Planning Process

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Planning Manual Part II: Risk-Informed Planning

U.S. Army Corps of Engineers
Institute for Water Resources

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FOREWORD

The Planning Manual Part II: Risk Informed Planning documents the state of the practice in risk-informed planning for the US Army Corps of Engineers (USACE) Planning Community of Practice. It is a continuation of the original Planning Manual, published by the USACE Institute for Water Resources in 1996. Since that time there has been a tremendous advance in standardization of risk language, the tools of risk assessment, and the practice of risk analysis within USACE. Part II of the Planning Manual describes the confluence of the six-step planning process with risk analysis processes, and complements the original Planning Manual by describing how planners use risk-informed planning to make decisions.

Risk-informed planning embodies all the principles and tasks of the USACE risk management framework and the six-step planning process. In risk-informed planning the familiar "beehive" planning model of the six steps is repackaged to incorporate risk management and to reflect the evolving state of the art and science of water resources planning. This paradigm shift to explicitly assessing and managing risk is more important than ever in meeting the USACE Civil Works mission.

Planning has always been about solving problems and making decisions under uncertainty. The risk management framework is a decision making framework for making decisions under uncertainty. With today's complex challenges and limited resources we must be more efficient and effective in how we conduct planning studies. The approaches and techniques described in this manual provide planners with tools to efficiently reduce uncertainty by gathering only the evidence needed to make the next planning decision and to manage the risks that result from doing so without more complete information.

Since the inception of "SMART Planning" in 2011, USACE Planning has engaged in a significant transformation in how we plan to better incorporate risk-informed, decision-focused thinking into our planning processes. The Planning Manual Part II: Risk-Informed Planning articulates the way we should be planning in the 21st century and serves as the basis for our transformed approach to planning.

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Chapter 1
Introduction

"You're off to Great Places!
Today is your day!
Your mountain is waiting,
So... get on your way!"
— Dr. Seuss, Oh, the Places You'll Go!

1.1 Introduction

Planners imagine better futures and plans that take us directly to them. That is exciting work. Anyone who spends part of their day envisioning better tomorrows and ways to get there must count themselves lucky. The United States Army Corps of Engineers (USACE or Corps) has been continuously engaged in water and related land resources planning since the early 19th century. Navigation improvements were the primary focus during USACE's first century; flood risk management, then called flood control, was added as a major planning function in the first half of the 20th century. Its Civil Works authorities and activities were substantially expanded in the last century, including the addition of environmental preservation and restoration in its second half. USACE has a long and distinguished history of water resources planning.

Relatively few USACE planners begin their careers as academically trained planners. Most of them learn on the job. One of the first things to learn is that there is a planning process. Knowing and practicing this process is the single best way to become a good planner. This manual is about the USACE planning process as it looks early in the 21st century. Its role and purpose is implicit in its title, the *Planning Manual Part II: Risk-Informed Planning*. The *Planning Manual* (Yoe and Orth 1996) 1996 remains the foundation document for the USACE planning process. That manual was developed to help planners implement the planning process described in the 1983 *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (U.S. Water Resource Council 1983). It remains a timely and valuable resource for all USACE planners. This manual is a companion to the 1996 *Planning Manual*. Its primary purpose is to articulate how to extend the USACE planning process into the world of risk and decision-making under uncertainty.

Planning has continued to evolve and change in the 20 years since the 1996 *Planning Manual* was written. The emergence of risk analysis as an effective framework for making decisions under uncertainty has been one of the biggest changes in that time. Planning obviously requires making decisions under uncertainty, so it is time to merge risk-informed decision-making and the continuously evolving practice of water resources planning. That is what this Part II to the *Planning Manual* does. As such, this manual is not an update to the *Planning Manua*l as much as it is a continuation of it.

1.2 Purpose and Audience

The primary purpose of this manual is to explain how planning changes when it is informed by risk. Like its companion, this manual focuses on how to practice planning. It is not about policies, programs, budgets, or politics, which are all subject to change. This manual is about the practice of good planning. It is aspirational in places. That means it does not always describe current practice and sometimes it functions as a bridge to a future that is not quite yet formed. It uses the same six-step planning process used since 1983 but repackages them into four tasks and two ongoing processes. It speaks of identifying a tentatively selected plan (TSP) that may not be the National Economic Development (NED) plan. It describes ways to document planning that are quite different from current policy planning documents. For the most part, this manual embraces common USACE practice, but risk-informed planning cannot be done the way planning has been done. At times, this manual pushes planners to expand their approach to familiar tasks.

There are three targeted audiences for this manual. The first of these is the new USACE planner. A new planner has five years of experience or less. New USACE planners are challenged not only to learn the planning process but also to learn the risk analysis paradigm and the USACE approach to risk management. The second audience is the experienced USACE planner who is wondering what all this risk talk is about and how it affects the planning process. The third audience includes anyone who does business with USACE planners. With limited budgets for studies, USACE and its partners must strategically reduce uncertainty through the planning process. Understanding how risk informs the planning process is essential for anyone who does business with USACE.

This is Part II of the *Planning Manual*, 20 years later. It does not repeat the guidance or planning procedures found in the original *Planning Manual (*Yoe and Orth 1996*)*. However, it does explain how uncertainty challenges and risk informs planning in the 21st century. Every foray into the planning process is a new adventure, and you will find good practices here, but it is up to you to figure out when and how to use them effectively.

This manual is most congruent and complete, if read from cover to cover. Gone is the so-called *beehive planning model* that graced the rear cover of the *Planning Manual*. In its place, is the familiar six steps extant but repackaged into four tasks and two ongoing processes to reflect the evolving view of planning as the first step in a project's life cycle, a process modernized by the USACE SMART Planning initiative, and a process that responds to USACE's call to become a risk management organization (for information about SMART Planning in USACE, go to: http://planning.usace.army.mil/toolbox/smart.cfm)

1.3 Organization of the Manual

This manual consists of 12 chapters. Following this Introduction, Chapter 2 provides a brief introduction and overview to planning as it introduces a new way to depict the six-step planning process. The heart of the planning process is the people who do the planning. The planning team is the focus of Chapter 3. Chapters 4 and 5 provide the risk and uncertainty background that is transforming the planning process. Chapter 6 describes the first major planning task, *Scoping*. *Evidence Gathering*, an ongoing process to effectively and strategically reduce the uncertainty in the planning process, is described in Chapter 7. *Plan Formulation*, the second planning task and the most creative part of the planning process, is the subject of Chapter 8. Chapter 9 describes the

evaluation and comparison work that comprises the bulk of the third major planning task, *Deciding*. The fourth and final planning task, Implementation, is the topic of Chapter 10. Chapter 11 addresses the importance of telling your story when you document the planning process. The manual concludes with a chapter on *Stakeholder Engagement*, the second ongoing process that, like *Evidence Gathering*, spans the planning process from start to finish.

1.4 Five Points to Take Away

Here are five key points to take away from this chapter.

1. USACE is one of the world's most experienced water resource planning organizations.
2. There is a planning process; if you are going to be a planner, you need to learn it and use it.
3. This manual, The *Planning Manual* Part II, merges risk-informed decision-making with planning.
4. The original *Planning Manual* remains a timely and useful resource; Part II will not be understood unless Part I is understood.
5. This manual is for new USACE planners and experienced ones who want to know what this risk stuff is all about.

1.5 References

U.S. Water Resources Council. (March 10, 1983). *Economic and environmental principles and guidelines for water and related land resources implementation studies*. Washington, DC: U.S. Government Printing Office.

Yoe, Charles and Kenneth Orth. (1996). *Planning manual*. Institute for Water Resources (IWR) Report 96-R-21. Alexandria: Institute for Water Resources.

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Chapter 2
Planning

"Unless someone like you cares a whole awful lot, nothing is going to get better. It's not." — Dr. Seuss, The Lorax

2.1 Quick Start

Every electronic device purchased has a quick start guide. Here is the quick start guide to the planning process.

1. Write down the problem to be solved.
2. Think up as many solutions for the problem as possible.
3. Make a list of things that will change if this problem is solved.
4. Write down the pros and cons of the different solutions.
5. Pick the best solution and explain why it is the best.
6. Document the results of the previous steps in a narrative story.

The rest of it is just details, but there are some important details.

2.2 Introduction

This chapter expands on the quick start above and updates the USACE planning process. The next section summarizes the Planning Modernization initiative that has propelled the planning process forward. These changes give rise to a new term of art, risk-informed planning, which is defined and described in the following section. The six-step planning process is reviewed before an updated depiction of the USACE planning process is introduced. Planners are reminded of the iteratively structured nature. Planning for a new planning study start is the last substantive topic of this chapter. Three specific iterations of the planning process are recommended as an efficient and effective way to reduce uncertainty in a new planning study start.

Where it starts nobody knows

The planning process can begin at any step. Following Hurricane Katrina's devastation in Louisiana many people were heard saying some version of "We need a category 5 hurricane wall." That is a process that begins with a solution. That is an ugly way to begin a planning process, but the process begins wherever it begins.

2.3 Planning Modernization

During the latter part of the 20th century, there was little appetite for risk in USACE's water resources planning mission. As a result, planning investigations grew bloated, taking a long time and costing a lot of money. More importantly, the amount of time and data invested in these studies was not leading to better products or decisions. As a result, local sponsors, Congress, and USACE were all growing increasingly frustrated with the situation. USACE found itself in a change or be

changed situation that threatened their national relevance. USACE decided to change. On February 8, 2012, Deputy Commanding General for Civil and Emergency Operations, Major General Michael J. Walsh, signed a memorandum that set in motion a sequence of events that have helped transform the manner in which water and related land resources planning is accomplished. There were five conceptual pillars or imperatives for change that comprised this reorientation of the planning process:

1. Uncertainty and level of detail: Balancing the level of uncertainty and risk with the level of detail of the study
2. Vertical team integration: Ensure early vertical team engagement of decision makers and as the study process progresses
3. Determine Federal Interest: Identify the Federal Interest early in the study, including the level of Federal Interest and level of federal investment looking beyond NED and National Ecosystem Restoration (NER)
4. Alternative comparison and selection: This concept recognizes there is no single best plan, and there are a variety of approaches (quantitative and qualitative) to multicriteria decision-making
5. Funding and resourcing: Ensure all resources needed for the study, i.e., funding, human resources, data, and information, are identified and available for the duration of the study

The first pillar opened the way for risk-informed planning by recognizing that planning required USACE to make decisions under far less than perfect certainty. It was also recognized that many of the engineering design details that had become part of the planning process were not necessary to make planning decisions. However, by making these decisions with less information than before, there was necessarily going to be an increase in some kinds of uncertainty. The need to manage the effects of uncertainty on planning decisions has provided the impetus for integrating planning and risk management in risk-informed planning.

Vertical team (VT) integration was seen as the most essential change in the planning process. The vertical team comprises the project delivery team (PDT), the Major Subordinate Command (MSC), USACE, the Army, and the local sponsor. Planning and risk management decisions traditionally made by the PDT are owned by the entire vertical team. Agreements made by the vertical team need to be honored by the vertical team for the duration of the study or until the vertical team agrees to amend them.

There is a renewed zeal for identifying the Federal Interest in a potential water resource project early in the study. Significantly, this new initiative empowered the vertical team to look beyond NED and NER to define a Federal Interest. This includes life, health, and safety risks.

The importance of comparing and therefore formulating alternative plans was reaffirmed. The potential to select a plan other than the NED plan based on additional comparison and selection criteria is recognized in the reference to multicriteria decision-making.

An essential element of Planning Modernization is the commitment of funds and resources adequate to complete the study. This requires that funding, human resources, data, and information are identified and available for the duration of the study. This, in turn, has given rise to a stronger emphasis to complete most studies within three years and within a constrained budget.

2.3.1 SMART Planning Tools: The Decision Management Plan (DMP) and the Risk Register (RR)

The five pillars of Planning Modernization presented an implementation challenge when they were first introduced. SMART Planning is the name given to the initiative that implemented these pillars. A named initiative provided the opportunity to introduce some changes that have since been wholly incorporated into the current planning process. Thus, SMART Planning has simply become planning. Nonetheless, two planning tools developed during that time are worthy of mention and some explanation; they are the decision management plan (DMP) and the risk register (RR).

Planning Modernization emphasizes using just the information needed to make the next planning decision. Because planning is naturally iterative, there is always another opportunity to revise a decision during the planning process. The DMP was developed as a tool to aid the transition from a study process that emphasized getting as much detailed information as possible to a process guided by the strategy of just in time information, i.e., collect only what is needed and only when it is needed. The DMP is used by the vertical team to guide decisions through the planning process.

No matter where the study team is in the planning investigation, the PDT identifies the next major planning decision to be made. Examples of major decisions include scoping the study, the first iteration, screening measures, formulating plans, evaluating plans, letting a major contract, and so on, whatever it may be.

Once the decision is identified, the next step is to identify the sequence of events required to make that decision. What has to happen and in what order for the team to reach a position to make this decision? These events can include data collection, analysis, stakeholder engagement, collaboration, and deliberative actions that will be necessary to make the identified decision. The DMP then identifies the specific criteria that will be used to make the decision. These might include specific positive or negative environmental consequences, costs, benefits, legal opinions, plan effects, stakeholder views, and the like. Specific metrics used to measure these criteria are also identified so that the vertical team's expectations of the quality of the decision are aligned. Take costs for example: the metric could be a qualitative rating such as high, medium, or low; an ordinal ranking from least cost to greatest cost would mark an improvement over the qualitative rating approach; costs could be estimated parametrically or with varying levels of design detail (10 percent, 20 percent, and so on). The DMP should inform everyone in order to manage expectations.

If there are important thresholds for any criteria, they should be identified and noted. For example, costs may need to be below a certain value, or water quality impacts cannot exceed certain regulatory limits. Net benefits greater than zero are another common threshold. Once the criteria and any thresholds are identified, the person with lead responsibility for gathering the data and completing the analysis by a specific date is identified. The vertical team needs to understand who will develop the information and when. Next, the DMP identifies the decision makers and the date by which the decision is to be made. Some decisions may be made by different members of the

vertical team. For example, the PDT may make some decisions while other decisions will require the entire vertical team. The DMP also includes a schedule for documenting and vetting the subject decision. A DMP document should be as succinct as practicable.

In the course of identifying a plan of action for making the next major planning decision, the DMP describes what will be done, and in so doing, it suggests what will not be done. Making decisions without detailed information entails uncertainty and risk. A RR is completed for each DMP. The RR identifies the actions that will or will not be taken as part of the DMP that could result in undesirable consequences for the affected communities, the study budget or schedule, implementation of the project, or project outcomes. The PDT qualitatively assesses the risks of these actions and identifies the resulting medium and high risks. High risks are to be carefully managed to prevent their occurrence or to minimize their impacts. Medium risks are to be monitored. All aspects of this assessment are summarized in the RR.

The DMP and its accompanying RR are vetted through the vertical team. The DMP plan of action is executed, and the next DMP/RR pair is prepared. This continues until the study is halted or the TSP is identified. The DMP-RR pair is considered to be for the internal use of USACE although it may be shared with anyone the vertical team deems appropriate.

2.4 Risk-Informed Planning

Planning Modernization has necessitated risk-informed planning, but what exactly does that mean? The original *Planning Manual* (Yoe and Orth 1996) defined planning as the deliberate social or organizational activity of developing an optimal strategy for solving problems and achieving a desired set of objectives. This manual defines planning as thinking carefully about the future and how best to get to the most desirable future from the present. Planning's purpose is to envision and shape the future by anticipating, identifying, and solving problems as well as seeking and capitalizing on opportunities.

Planning's future orientation guarantees it is fundamentally about making decisions under uncertainty. Risk analysis is a decision-making framework that has evolved specifically for making decisions under uncertainty. The confluence of planning and risk was inevitable. Thus, risk-informed planning is born. Risk-informed planning pays careful attention to uncertainty, and it uses a set of risk performance measures, together with other considerations, to *inform* planning[1]. Risk-informed planning is an analytic-deliberative process. Figure 2.1 illustrates the many cycles of analysis followed by deliberation and decision-making that define the planning process. Think of the analytical steps as efforts that reduce but can never eliminate uncertainty. Think of the deliberative steps as decision-making under uncertainty. The PDT's challenge in a world of limited time and budget is to efficiently reduce uncertainty by gathering only the evidence needed to make the next planning decision and to manage the risks that result from doing so without more complete information. Keep in mind that any one of these analysis/deliberation cycles can be iterated several times; this is risk-informed planning.

1 Risk-based planning would make decisions based solely on risk metrics.

Figure 2.1: Planning shown as an analytic-deliberative process

2.5 The Planning Process

The USACE uses a six-step planning process that has evolved over the better part of the 20th century and which was most completely articulated in the 1983 *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (Principles and Guidelines or even more simply referred to as the P&G). Those steps form the heart of this manual. They are:

1. Specification of water and related land resources problems and opportunities (relevant to the planning setting) associated with the federal objective and specific state and local concerns
2. Inventory, forecast, and analysis of water and related land resource conditions within the planning area relevant to the identified problems and opportunities
3. Formulation of alternative plans
4. Evaluation of the effects of the alternative plans
5. Comparison of alternative plans
6. Selection of a recommended plan based upon the comparison of alternative plans

Planning has continued to evolve since the 1983 P&G, an evolution that now includes its confluence with risk analysis. Step 1 has always been a scoping step that includes more than identifying problems and opportunities. The data gathering of Step 2 is an ongoing process that extends throughout the planning process, no longer conveniently confined to or described by a single step. Formulation remains the creative heart of the planning process. The evaluation and comparison tasks of Steps 4 and 5 combine into a comprehensive decision-making process. Step 6 is evolving into something more complex than plan selection given USACE's life cycle, risk-management emphasis. None of these changes supplant any of the six steps, but they do afford the opportunity to represent the six-step planning process more effectively as shown in Figure 2.2.

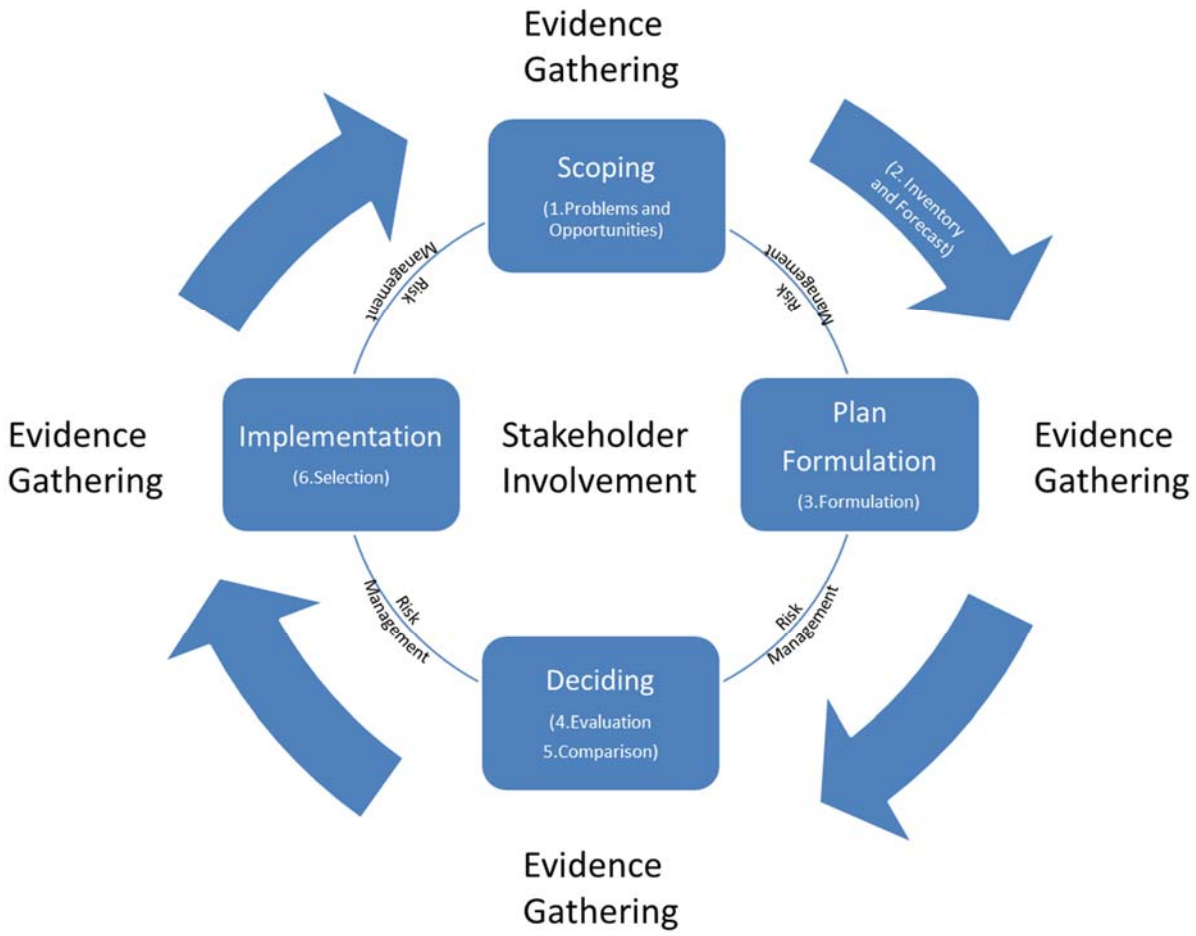

Figure 2.2: USACE Risk-Informed Planning process

Conceptually, there are four major groups of tasks depicted by the rounded rectangles. For simplicity, these will be referred to as tasks in the remainder of this manual. They cover scoping the planning investigation, formulating alternative plans, making decisions about those plans through a process of evaluation and comparison, and moving into the implementation stage of the project life cycle by identifying the recommended plan from among the plans formulated. Stakeholder

Iteration Frequently Asked Questions (FAQs)

What is an iterative process?

An iterative process is one that is repeated, at times, over and over.

What is iterated?

The entire planning process, a single step in the process, or any portion of the process can be iterated.

What do planners do in an iteration?

They attempt to reduce uncertainty with each iteration of the planning process. Iterations repeat, elaborate, refine, correct, or complete a part of the planning process.

Why is the planning process iterative?

Uncertainty is the primary reason. Uncertainty could increase or decrease with new information; you learn as you plan. As more information becomes available, your understanding improves, and it is often necessary to go back over something to make it better.

How do iterations differ from one another?

They differ primarily with regard to the information that is available and the detail included in the plan. If we talk about complete iterations of the planning process, a 5-day iteration at the start of a new study will not be as good as the 100-day iteration. The emphasis in the iterations likely will differ. Early iterations tend to emphasize problems; later iterations emphasize solutions. If we talk about iterations of a single step, the level of detail is usually the primary difference.

How long does an iteration last?

It depends on whether we are talking about an iteration of the entire process or of a single step. An iteration of the process tends to take longer than an iteration of a step. However, any iteration can take an hour, a day, a week, or longer.

How many iterations are required?

If you are trying to count iterations, you are missing the big picture. There is no prize for either the most or the fewest iterations. You do as many iterations as it takes to arrive at the best plan.

When do you stop the iterations?

When all of the planning steps have been completed as fully and as well as they are going to be done in your study effort, the iterations can stop. It is time to identify the tentatively selected plan.

involvement is at the center of this planning process, which takes place within a continuous process of evidence gathering and uncertainty reduction. The thread that unites the steps, surrounds the stakeholder engagement and mirrors the evidence gathering is risk management. Each of these tasks and processes is the subject of a subsequent chapter where they are explained in detail. Notice that the six steps of the planning process are identified in the tasks and processes. The cyclical nature of the figure depicts the iterative nature of the planning process. The process always begins with scoping and it always ends with implementation. For now, let us consider the nature of this process rather than its details.

2.5.1 Planning is Structured and Iterative

There is a planning process. It has four tasks and two ongoing processes that envelop the six steps. There are tasks to accomplish and processes to do in a rational order. This structure gives planners a predictable and reliable way to proceed through the chaos of the most ill-formed problematic situations to a set of plans. The process is a cycle of deliberation followed by analysis (yes, the order was intentionally flipped) that ultimately leads to a recommended course of action.

Ideally, planning begins with scoping and it eventually ends at implementation, but few planning efforts are ideal. In reality, planning can begin at any point in the process. It may begin near the end when a local sponsor presents a plan to implement; for them, formulation and screening are complete. A process may begin at the beginning when Congress hands USACE its initial problem statement with a new study start, or it could begin in the middle when sufficient evidence of a problem accumulates. It does not matter where the process begins; what matters is that each of the steps in the process is completed at

least once. To assure that this happens, the planning process is iterative by design. An iterative process is a reasonable adaptation to a world of uncertainty. Studies, however, always begin at the beginning with scoping. They proceed to the end, and they always stop at implementation. The path from scoping to implementation can be circuitous. It can involve discontinuous leaps and long delays. It is a rare study that travels a smooth path from scoping to implementation.

Although the process is laid out linearly in the chapters of this manual, it is practiced iteratively. The big picture view is that the planning steps are repeated. You do something, then you do it again. The initial iteration of a step may be little more than an educated guess because of the uncertainty faced. Subsequent iterations may be completed because there is more definitive data, or there may be simple fine tunings of an earlier result. Both the analytical and deliberative work are iterative. As evidence is gathered and uncertainty is reduced, our understanding of problems, objectives, potential solutions, and their effects are all improved. As we fill gaps in our data, we had better understand which remaining gaps are most important to fill. This improved understanding directs and influences the remaining analysis.

Planning decisions are also iterative. Increasingly discerning and discriminating decisions are made throughout the planning process. We decide what measures are applicable or not, then we begin to build plans and to move them forward or back based on rather coarse criteria and judgments that get better as the process progresses. As uncertainty is reduced, decisions are more deliberative and discerning, yielding greater confidence.

2.5.2 New Planning Study Start

A reasonable goal for a new planning study is to complete three iterations of the entire planning process during the course of the study. The PDT should complete its first iteration of the planning process within the first 30-days of the study's initiation. This first iteration will be conducted under the highest degree of uncertainty of the three iterations. The team goal for evidence gathering is to use readily available existing knowledge and data without generating any new information to complete this first iteration. The PDT will never know less than they do for this iteration. That makes it the most informative iteration of all because it will reveal information at the same time it teaches the PDT what they do not know.

Reminder

There is the planning process and then there are planning policies and procedures. The USACE uses a system of milestones to manage and monitor the progress of its studies. These three iterations will not be found in the milestones; they are founded on nothing more or less than good planning practices.

Ideally, this first iteration will include a PDT field trip to the study area followed by a solid day of planning to initially scope the study. The result of this initial scoping will be six distinct pieces of paper covering the following:

1. Problems and opportunities statement
2. Narrative description of without condition
3. List of planning objectives and constraints
4. List of decision criteria to be used for formulation, evaluation, and comparison
5. List of questions decision makers would like to have answered

6. List of most significant uncertainties in study

Using these six pieces of paper, the PDT should then complete a preliminary identification of measures, and a formulation of several alternative plans. These plans ought to be coarsely screened to get a feel for what the team thinks the eventual TSP might be. This will mark the first iteration of the planning process in a very preliminary fashion, and it should be completed within 30 days of starting the study. Now, the PDT better understands what it does not know.

The second complete iteration of the planning process ought to be finished within the first 100 days of the study. This second iteration will focus on reducing the most significant uncertainties identified in the first iteration as much as is possible in the first 100 days. This will normally require relying on data collected by others and some preliminary evidence gathering and investigation. This iteration may also include some analysis of the available data that could not be completed within the first 30 days. It is characterized by a growing database and the first crude calculations and estimates of selected decision criteria.

The third iteration will be completed within three years or according to an alternate schedule established by the vertical team. This is typically the final planning process iteration that results in a TSP. It relies on the detailed analysis undertaken as part of the evidence gathering and uncertainty reducing process. There may be additional iterations of individual steps or iterations of analytical tasks, like refining cost estimates or other calculations, after this final iteration of the planning process.

2.6 Five Points to Take Away

Here are five key points to take away from this chapter.

1. Risk-informed planning is the confluence of the USACE planning process and the USACE risk management orientation.
2. Risk-informed planning is completely faithful to the USACE six-step planning process.
3. Risk-informed planning has four major tasks with stakeholders at their center in a continuous process of evidence gathering and uncertainty reduction that is united by a risk management orientation.
4. Planning is iterative by its nature; it must be iterated.
5. Planning Modernization, aka SMART planning, has transformed the USACE planning process.

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Chapter 3
Planning Team

"Everything stinks till it's finished." — Dr. Seuss

3.1 Introduction

With apologies to Dr. Seuss, here is what we imagine he might have said about planning teams had he given them any thought.

You are the toughest critic you'll ever meet
To rely on yourself is not very neat
Instead of complaining your project's not fun
Power through it together, get it finished and done
When your plan is complete
Go back and revise it
Then cross your fingers
No one will despise it
The trick's to be vertically aligned
So planning is fun, no one feels maligned.

A team is a group of people working together to produce a specific result or outcome. Planning is a team sport, and two heads are better than one anyway, so planning is done in teams. A team of people with diverse expertise, talents, and skill sets can deliver much better solutions than any one individual could ever hope to do. The team offers access to a wider range of skills and knowledge and a deeper well of energy that enables them to solve problems faster and better than an individual or a collection of individuals can.

Every individual brings a unique set of personal qualities to the team:

- Expertise - The technical background people began learning in school and now practice professionally.
- Talent - Skills and abilities not necessarily related to technical expertise such as leadership, writing, and speaking.
- Affiliation - The groups people are formally associated with and represent, including employers, political, religious, fraternal, and other groups to which they belong.
- Personal values - What we each believe is right and wrong, good and bad, the answer or not the answer.
- Personality - The essence of what makes each of us individuals. Are we introverts or extroverts, logical or intuitive; just how do we approach each day?

Transdisciplinary teams are better than interdisciplinary teams, which are better than multidisciplinary teams, which are better than uncoordinated group efforts, which may be better than individual effort, which may be better than nothing. The very best teams are transdisciplinary; your team should, at least, be interdisciplinary.

An uncoordinated group is not a team. A multidisciplinary team is a group of diverse experts who tackle complex problems together. The integration of their various disciplines is never a focus of the effort, and the work of such teams often has the flavor of a series of well-connected analyses that ideally add up to something

meaningful. Assembling the right disciplines is regarded as the hurdle to leap. Although a multidisciplinary team is a substantial improvement over an uncoordinated group's effort, little effort is expended to integrate the various disciplines.

Multidisciplinary teams are limited by the fact that disciplines have, over time, developed their own specific and occasionally peculiar way of looking at the world. Effective solutions to complex problems require a better integrated view of the problems and their solutions. An interdisciplinary team also begins with a rich diversity of expertise. It differs, however, by its intentional effort to integrate the various disciplines in a way that better recognizes the big picture of a planning effort. An interdisciplinary team crosses traditional boundaries between academic disciplines or schools of thought and weaves more holistic viewpoints of planning issues among its members. Interdisciplinary solutions tend to be more responsive to social needs.

The experts in an interdisciplinary team come to understand the language and basic concepts of the other disciplines and their perspectives. This enables engineers to appreciate and consider the viewpoints of economists and environmentalists. This can lead engineers to more economical and environment-friendly designs. Likewise, economists understand the importance of non-monetized values reflected in other disciplines. This may lead them to use cost-effectiveness and incremental cost analysis of non-monetized plan effects.

A transdisciplinary team not only crosses traditional boundaries among disciplines, it erases those boundaries and integrates knowledge at the edges of disciplines. A transdisciplinary approach bridges many disciplines at once and develops a synergy among disciplines that can create new insights, and ways of looking at problems and their solutions that transcend the abilities of traditionally bounded disciplines. As new needs and new disciplines emerge, transdisciplinary approaches that bridge and accommodate these changes are increasingly valuable. The most exciting disciplines, now, are those that integrate the traditional ones. Transdisciplinary knowledge is greater than the sum of all the disciplines that comprise it.

This chapter is about the planning team. Following this introduction, it turns its attention to the vertical team. This is the keystone concept of the USACE risk-informed planning model. The discussion focuses on vertical team alignment and the project delivery team. Next, the chapter examines the transition from group to team. The stages of a team, a team charter, team roles and the study manager's role in team development are emphasized. Team meetings are an essential part of the planning process and the bane of many a planner's existence, so the elements of a good team meeting are addressed next. The final topic of the chapter is the vertical team's risk management responsibilities. The chapter concludes with five points to take away from this chapter.

3.2 The Vertical Team

Planning activities and the core of the planning team are generally rooted in the District Office. Successful planning, for USACE, however, requires the vertical engagement of the organization and so the planning team is, in fact, a vertical team. The exact makeup of the vertical team may vary from study to study, depending on the study's scope and complexity. The four levels represented on a vertical team are, however, consistent and include the District, MSC, Headquarters, and Planning Centers of Expertise (PCX) as shown in Figure 3.1.

The District members of the vertical team include the PDT and appropriate supervisory personnel from the District. The MSC representatives may include the MSC Planning Chief and other experts who can contribute to the plan. A deep draft navigation study may include MSC experts who can

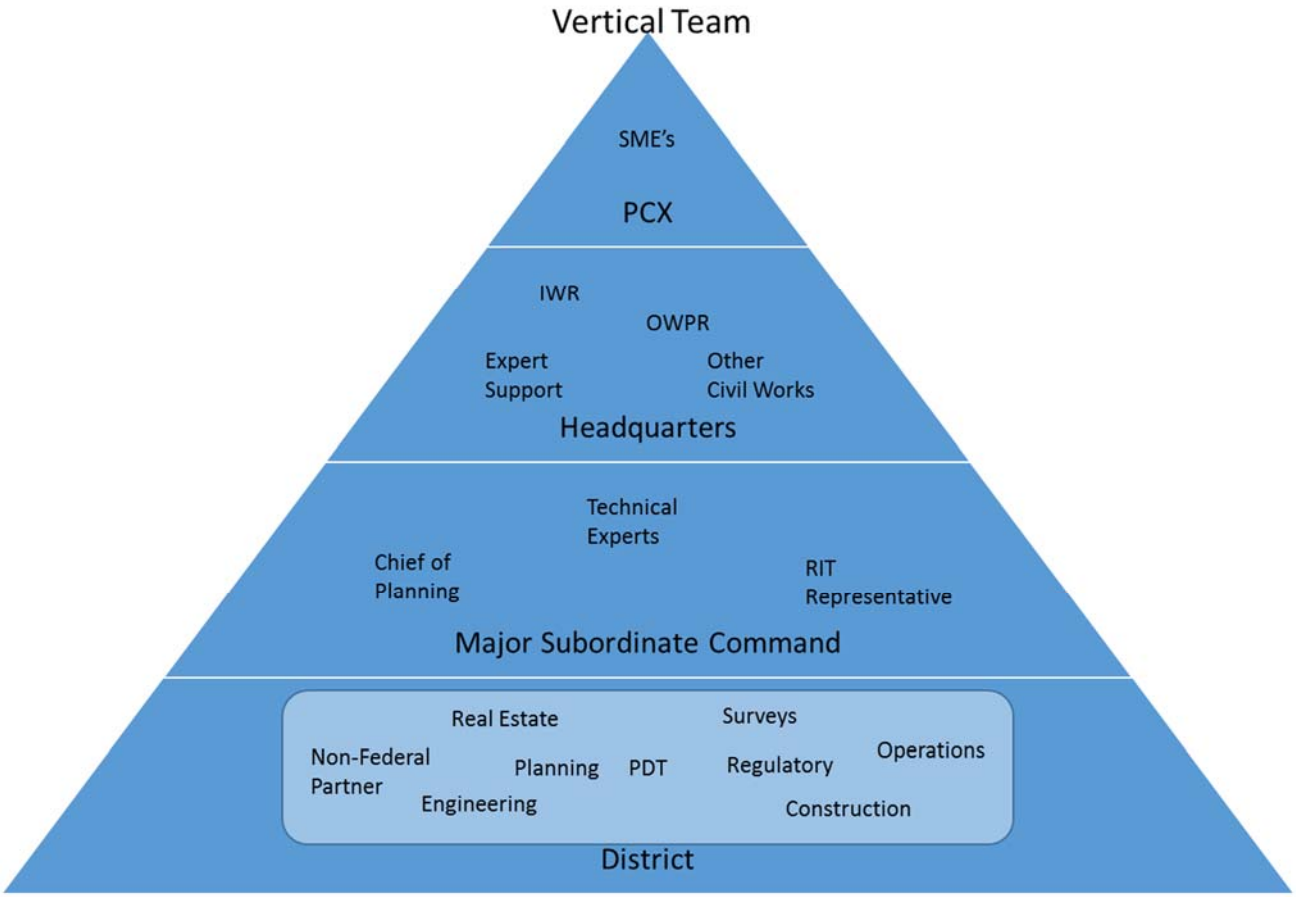

Figure 3.1: Vertical team's potential membership

contribute to the plan. A deep draft navigation study may include MSC experts in plan formulation, navigation, economics, environmental, and engineering disciplines. Each MSC has a Regional Integration Team (RIT) representative at Headquarters. This person provides a single point of contact for the MSC at Headquarters. Because the RIT representative processes all MSC work products that require Headquarters-level review, that person ought to be part of the vertical team. Headquarters representatives may include Office of Water Project Review (OWPR) economics, environmental, and/or plan formulation experts, technical expertise from Engineering and Construction, social science support from the Institute for Water Resources, or experts from other Civil Works operations. Representatives from the appropriate PCX can provide subject-matter expertise and experience as needed (i.e., subject matter experts or SMEs).

The vertical team serves the USACE risk management function for planning, making its members at each level risk managers. The vertical team is jointly responsible for the planning study undertaken by USACE. The Chief's Report provides risk management measures for the communities affected by the planning investigation; this is one of the vertical team's primary risk management

responsibilities. They are also responsible for managing study and implementation risks that can result from the conduct of the study.

3.2.1 Vertical Team Alignment

Vertical team alignment is not groupthink. It does not mean everyone will see things the same way or think the same things. The ultimate goal of aligning the vertical team is to identify and solve issues as early as possible in the planning process. Vertical team alignment means getting the entire vertical team engaged early in the planning process and maintaining a consistent and effective level of engagement throughout the planning process.

> …a coordinated USACE District, Division, and Headquarters vertical team will be deployed throughout the project development process in a One-Corps approach to identify and resolve policy, technical, and legal issues early in the process.
>
> http://planning.usace.army.mil/toolbox/smart.cfm?Section=1&Part=1
>
> Accessed February 4, 2016.

The entire vertical team needs a common vision of how the planning study will proceed, how much uncertainty can be tolerated, and how resulting risks will be managed. The vertical team needs to jointly own all the study's DMPs and its RR. They need to share responsibility for all complex and significant planning decisions as they arise. Having one common and shared USACE decision at all four vertical levels of the team simultaneously can reduce the need to repeat steps and refine analyses. Vertical team alignment is essential to SMART Planning's goals of saving time and money without sacrificing quality.

3.2.2 Project Delivery Team

The District PDT is the heart and soul of the planning effort. It is responsible for the day-to-day conduct of a planning study. The PDT consists primarily, if not exclusively, of District personnel. A typical USACE District is organized by offices that provide administrative support and divisions that conduct the business of the USACE District. One of those divisions includes the planning function. It may be a Planning Division or Planning could be a branch in a larger division. Study managers are usually attached to this Planning group as might other members of the PDT. The remainder of the PDT will be from the various divisions and offices in the District. Figure 3.2 shows the structure of a hypothetical PDT.

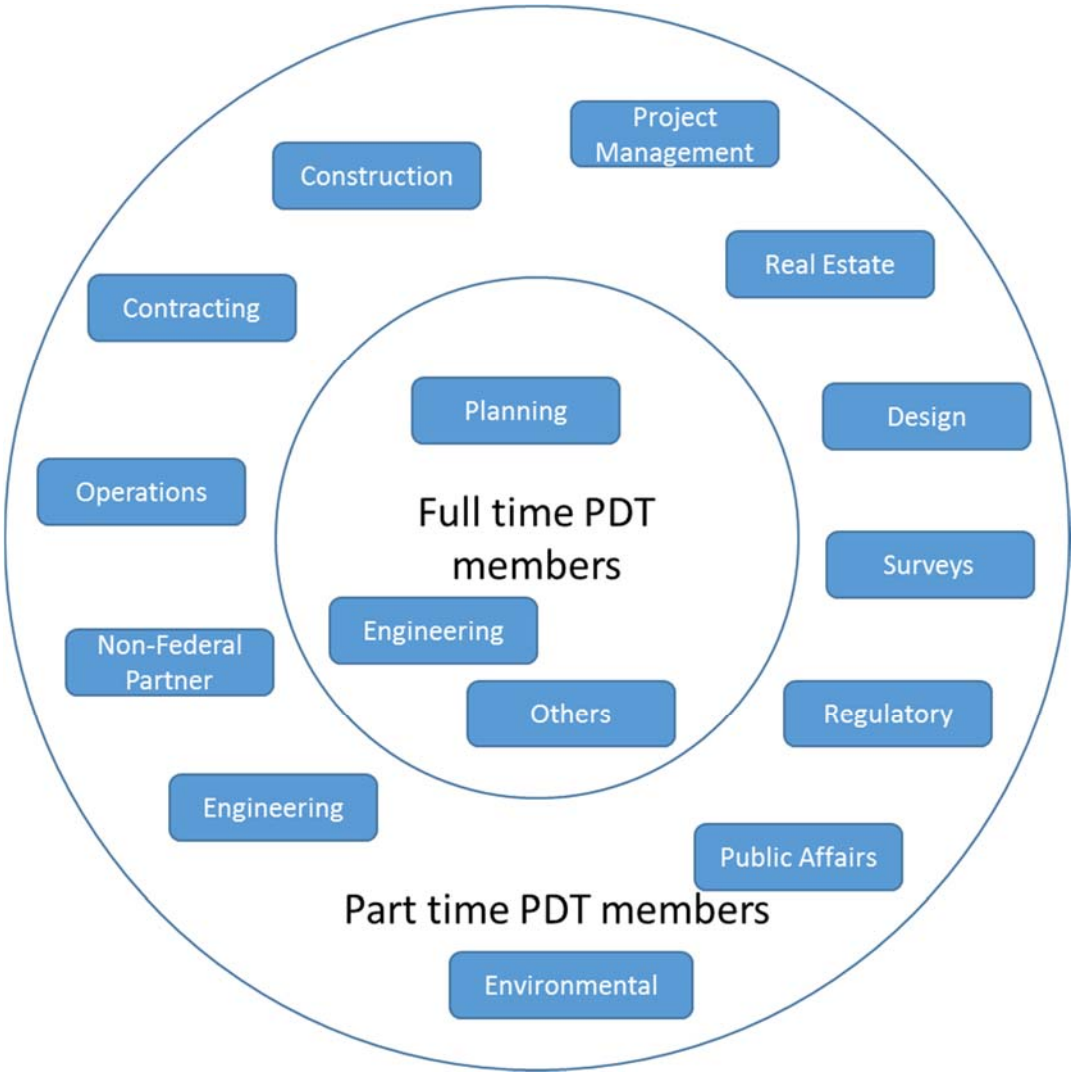

Figure 3.2: Conceptual structure of a typical project delivery team

A PDT will have a relatively small core of full time team members. These are people who will be involved with the study from its beginning to its end. They will typically come from planning, engineering, and other branches and divisions of the District. During the course of a study, various other District personnel will be needed on the PDT from time-to-time to perform certain functions, like assisting with contracts, surveying, conducting necessary analyses such as preparing cost estimates, or hydrologic analysis. These people may plug into and out of the PDT several times during the course of a study. There may be periods of time that involve them intensely as PDT members, followed by times when they have no involvement at all with the team.

3.3 From Group to Team[2]

Working in a planning team can be exhilarating if team members work well together or debilitating if people are pulling in different directions. A group of professionals coming together to work on a planning study is not the same thing as a well-functioning team. Professionals in any given group may sometimes work together, but they may also be inclined to work independently, simply pooling their work efforts with little or no discussion. Then they spend a great deal of time trying to resolve conflicts over work-related or personal issues. By contrast, members of an effective team always work together. Whether team members work physically together or apart, they are constantly aware of who is doing what. Team members take different roles and responsibilities, helping one another to the greatest extent possible. An effective team resolves disagreements amicably preventing personal issues from interfering with the team's functioning. With a group, the whole is often equal to or less than the sum of its parts; with a team, the whole is always greater.

What kinds of experts are likely found on a team?

- Architects
- Archeologists
- Biologists
- Civil Engineers
- Communications experts
- Cost estimators
- Hydraulic engineers
- Hydrologists
- Economists
- Environmentalists
- Geographers
- Geologists
- Geotechnical engineers
- Model builders
- Planners (yes, they exist!)
- Policy experts
- Political scientists
- Psychologists
- Realtors
- Risk communicators
- Risk managers
- Statisticians
- Sociologists
- Wildlife managers

3.3.1 Stages of a Team

Tuckman and Jensen (1977) defined five stages of a team's life as shown in Figure 3.3. The first stage provides the team with structure and clarity of purpose. When a team first forms, it is a group of individuals on the way to becoming a team. There can be a lot of ambiguity, uncertainty, and anxiety. The members may be strangers to one another, and no one knows who to trust or even if the leader is trustworthy.

2 The material in this section builds closely on the Team Management training materials of MindTools found at https://www.mindtools.com/ (Accessed February 6, 2016).

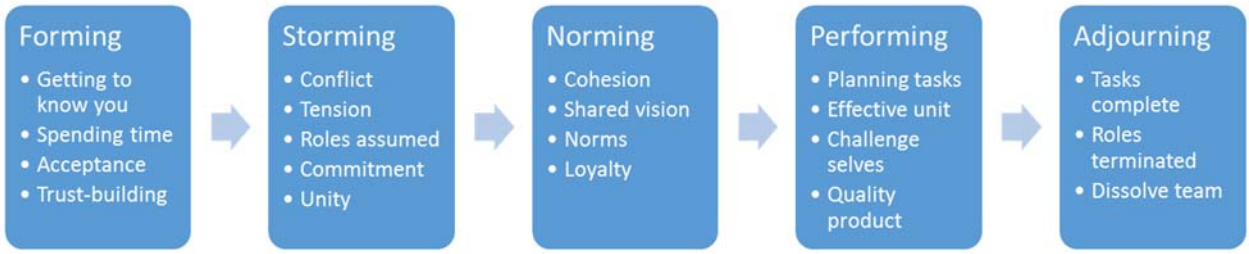

Figure 3.3: Tuckman and Jensen's model of team stages

In the forming stage, the team leader, who may or may not be the study manager, should help the group focus on acceptance and trust. It is too early to try to dive deeply into the planning process. Trust-building is crucial during this first stage. The team leader should invest time in free and open discussion that enables people to get to know each other. Spending time together establishing clear goals, expectations, and rules for how the team will work while allowing time for asking questions, sharing information, and being sensitive to team members' needs are important steps in building trust.

The storming stage is characterized by conflict. A wise team leader will focus his team-building efforts on team commitment and unity. As many individuals begin to work together, conflict and tension are bound to arise. Team members have different roles and responsibilities, leading to different perspectives. It is common for the members to question the direction of the study, the leader's capability, and their teammates' abilities. As people become more comfortable within the team structure, they are more inclined to express their thoughts and feelings and to exhibit their true personalities. This is when the team will (or will not) learn to deal with adversity and conflict. This is a critical stage for the team. Teams can be destroyed at this stage. Team leaders must realize this type of conflict is not bad; people are just becoming comfortable enough to be themselves and take sides on issues. The team leader's priority now is facilitating effective conflict management. Getting to yes, finding win-win solutions, and actively avoiding *groupthink* is what the job requires.

The resistance that arises in the storming stage is hopefully overcome in the norming stage. This is the time for the team to come together and build cohesion, differentiate roles, and share a vision. The team begins to develop its norms, and members begin to conform to the norms. If the norm is overspending, under-achieving, slacking off, and missing milestones, this is not a good thing!

In the norming stage, the initial uncertainty is gone, anxiety is reduced, and conflicts have been dealt with. Individual roles, mutual support, and commitment to the team are explored in this stage of the team's development. The more people work together, the more they begin to behave similarly. Loyalty to the team forms during this stage. Individuals' commitment to the team is expressed through cooperation, sharing information, ignoring disagreements, meeting obligations, and conforming to the team's standards of performance and behavior.

This is when many of the team members' roles, described later in the chapter, develop. In addition to technical roles, people begin to assume team function roles. Teams tend to get stronger or weaker at this point.

The best team leaders will notice who fills each type of role most naturally and then help these people build and use their skills keeping the team on track and working well together. Giving people feedback is especially important during norming. Leaders who can invoke a deeper meaning and purpose for the team at this stage will have the most successful teams. In-group feelings and cohesiveness develop, and new standards evolve to support the new roles people adopt.

In the performing stage, group energy is channeled into the planning process tasks. This is the time for accomplishing tasks and raising the overall team performance. Now, the team is working as an effective unit; conflicts and challenges of the previous stages have been worked out. The lack of trust is gone, the shared vision is strong, and this is the most productive stage of the team's life. The team leader's job is to find ways to help the team members continue to challenge themselves. That famous last kick by the team to finish tasks in a quality manner is simply the reward for surviving the earlier stages of the team's life.

The final stage of the team's development is adjourning and dissolving the team. All the tasks are complete, the roles are terminated, responsibilities are discharged, and the team returns to a group of individuals, no longer strangers.

Ideally your team will stay at the performing stage until the task is complete and the team adjourns. However, various events can cause the team to return to an earlier stage. When that happens the team needs to be mindful of the fact that they are no longer performing and take steps to address the issue and return the team to performing. For example, staff turnover can introduce a new team member with different ideas or perspectives, causing the team to return to storming. In this case, deliberate action must be taken to incorporate the new team member and again go through the norming process so that the team can return to performing. Teambuilding activities can also help if a team has digressed from performing. Teams must be constantly cultivated like gardens.

3.3.2 Team Charter

An underutilized important first step for turning a group into an effective team is to set a team charter to guide the team's functioning. Without sufficient direction, vertical teams can focus on the wrong objectives, they can fail to use people and resources effectively, they can be torn apart by avoidable infighting, and they can fail with dire consequences for the planning study. Team charters are simple team-generated documents that define the team's purpose, how it will work, and the expected outcomes. Mindtools (https://www.mindtools.com/pages/article/newTMM_95.htm accessed February 5, 2016) describes a charter as a *roadmap* to make sure all team members are clear about where they are heading. The charter gives the team direction when times get tough.

Team charters are best created, by the team, when the team is formed to make sure everyone is focused on the right issues from the start. When USACE begins a planning study, people are eager to charge right into data gathering, analysis, and technical work; this is the time for the vertical team to agree on a team charter. A charter can shorten the forming, storming, norming, and performing stages of team development and make a team effective more quickly. The precise format of a vertical team charter, a short and simple written agreement, will vary from study to study and from team to team, but the following elements provide a starting point for the team to consider:

- Context
- Mission and Objectives
- Composition and Roles
- Authority and Boundaries
- Resources and Support
- Operations
- Negotiation and Agreement

The context identifies the reason for the team's existence and its expected output. It can be as simple as: *To complete a feasibility study by producing a Chief's Report that responds to the study authorization.* The mission and objectives describe what the team has to achieve. This prevents people from pursuing diverse agendas. The mission of the team may be to develop a plan that reduces flood risks while restoring ecosystem function in an urban area. It may be common sense to adopt the study's planning objectives. For the vertical team, objectives may include milestone dates and dates for vertical alignment meetings.

The first PDT meeting will be on Tuesday, October 10, at 2:00pm.

The PDT will meet every Tuesday afternoon, thereafter, from 2:00pm to 3:30pm for the duration of the project. Each member will present a short status report for his/her study responsibilities.

If a member is unable to attend, a notification must be sent to the study manager and someone else shall be designated to report on the status of his/her work. A summary of each meeting will be prepared by the designated person and emailed to all vertical team members by the morning following the meeting. Vertical team members will identify any concerns with the summary within 48 working hours of the email being sent.

Vertical team composition and roles help ensure the effectiveness of the team. The vertical team must have the skills and expertise needed to do the job. They also need enough people to do the job but not so many that the study will bog down with coordination. The specific responsibilities of each member of the team need to be made clear, if not reduced to writing. Once the roles are defined, authorities and boundaries need to be established. It is important to clarify what team members can and cannot do to achieve the mission. This includes clarifying how much time team members will devote to the study and how they will resolve conflicts between other responsibilities and the team mission. It is useful to address what the PDT can and cannot do on its own, and what it needs prior approval to do.

The resources and support section of the charter should list the resources that are available to the team to accomplish its mission. This list would include budgets, time and schedule, equipment, and people. If any training or technical support is required, it ought to be noted here. An effective charter needs to address how the team will operate on a day-to-day basis. This can be as detailed or as minimal as the situation warrants. It may be comprehensive and detailed for a relatively inexperienced team or a few bullet points for an experienced team. This may focus on the PDT, but it should also include details of the desired communication schedule for the entire vertical team. The charter should briefly indicate how the vertical team will negotiate and reach agreement on important decisions.

A good team charter is negotiated. It is not prescribed by an Engineering Regulation or copied from another study. The mission may be determined by higher authority, but the vertical team members ought to establish the rest of the charter, and then honor it throughout the life of the study.

3.3.3 Team Roles

Good teamwork is essential to good planning. Good teams have role players. There needs to be a leader, of course, and there must be followers too. There are many other roles that recur on the more successful planning teams. Doers make things happen. They accomplish things. They push the team forward and pull it along when necessary by the progress they make. Doers are needed to get things done.

Visionaries see things that others do not, and they see in ways others cannot. They are those mythical people who think outside the box. Visionaries can direct their creativity into the task before them, see new possibilities, and call them into being. These are the people who can imagine circumstances, situations, and things that do not currently exist.

Thinkers are reflective, curious, and sometimes they are bulldogs. They can come back to an idea a week later and build on it because of the critical thinking they have done since it was introduced. Thinkers help keep the process moving forward.

Realists like to make sure they know what is in the box, and they want to make sure they have done their best in the box thinking before they are ready to move outside the box. Firmly grounded in the limitations of reality, they constrain the process to what is doable. Realists keep planning from spinning off into flights of fancy.

Reactors respond instinctively and, at times, emotionally. They blow hot and cold on ideas, sometimes on the same idea. They spur discussion by their incomplete enthusiasm. Reactors can change the direction of the process.

Skeptics know consensus is a poor substitute for evidence. A major role of the skeptic is to slow down and when necessary to break up snowballing groupthink ideas. The skeptic regularly asks, *How do we know it is so?* Or *What is our evidence?* Skeptics ground planning in facts.

Researchers remove uncertainty. They fill in the gaps in our knowledge and separate what we know from what we do not know. Researchers seek knowledge. They are planning's best weapon against uncertainty.

Bean counters and fact checkers save the team's hide, and its face. They are interested not only in getting the right science, but in getting the science right. They make sure the models are verified, check the calculations, and read the quantitative stuff others do not. They keep track of dollars and balance budgets. Bean counters and fact checkers are the team's quality control people.

Technology wizards are the miracle workers who translate ideas into tangible results. They make the amazing maps, build the models, master the websites, and do astonishing things with software you have used for years but did not know *it could do that*. They make digital things go. They understand the wires, and the best wizards can speak your language. Technology wizards make everyone more productive.

Peacemakers know that when emotions rise, data do not matter. They are good at seeing all sides of a disagreement, and they can dispassionately resolve conflicts within and without the team. Blessed be the peacemakers.

Writers communicate clearly with widespread audiences as well as with posterity. They are storytellers who understand storytelling is more important than the numbers. They write for their readers. Writers are a vital communication link.

Speakers communicate well with others in real time and face-to-face. They can marshal competence and expertise, empathy and caring, honesty and openness, or commitment and dedication as the circumstances require. Speakers are the public face of the planning effort.

Social networkers connect the team with the outside world. They know how to communicate digitally and can translate a technical appendix into 140 characters for your Twitter account. They are the people who know it is folly to flesh out this paragraph with explicit examples like Facebook, Instagram, and Pinterest because they will all be passé when you read this. These are the people needed to help get your story out.

What about the leader? This may be the most critical role of all. Every team needs a leader. A team leader can emerge from virtually anywhere in the team. Normally, the study manager, by virtue of his experience, demonstrated ability, and responsibilities will be the most logical candidate to be the team leader; however, that is not always going to be the case. In fact, teams have been crippled when the manager is not the leader and no other leader emerges from the team.

Fisher (1993) says the best team leaders have certain recognizable behavior competencies. These competencies encompass some of the roles described above and also include the leader as the living example, coach, business analyzer, barrier buster, facilitator, and customer advocate. These competencies or roles describe behaviors that would be valuable characteristics of any team leader. When they describe someone other than the study manager, that person may well be the real team leader, and that is okay.

The leader unleashes energy and enthusiasm by creating a vision that others find inspiring and motivating. The living example serves as a role model for others by *walking the walk* and demonstrating the desired behaviors of team members and leaders. The coach teaches others and helps them develop to their potential (more on this in the next section), maintains an appropriate authority balance, and ensures accountability in others. The business analyzer understands the big picture and is able to translate changes in the macro-environment to opportunities for the team. The barrier buster opens doors and runs interference for the team, challenges the status quo, and breaks down artificial barriers to the team's performance. The facilitator brings together the necessary tools, information, and resources for the team to get the job done and facilitates group efforts. The customer advocate develops and maintains close customer ties, articulates customer needs, and keeps priorities in focus with the desires and expectations of the customers.

The leader on a planning team may change from time to time. As the study begins, the person most familiar with the people and places of the study area may be the team leader. At certain points during the study, team leadership may migrate to other shoulders based on the technical expertise and skill set of the team member. As schedules tighten, money runs short, and the frequency and

importance of contact with the public increases, the study manager is more likely to resume the role of team leader. It is less important who leads the team than it is that it be lead.

3.3.4 Study Manager and Team Development

The study manager has many responsibilities prescribed in guidance. One often overlooked responsibility of a study manager is to develop the team, at least the PDT portion of the team. A typical team has individuals with different outlooks and abilities who are at different stages of their careers. Some may find their study responsibilities challenging; they are going to need support. Planning veterans may be very familiar with their assigned tasks and may be looking for opportunities to stretch their skills. Either way, it is a good study manager's responsibility, as the team leader, to develop the team and meet those needs. That means developing its individuals. The study manager who can help team members become better at what they do will be a manager people want to work with. The most effective way to develop team members is to give them effective and frequent feedback.

3.4 Good Team Meetings

The vertical planning team assembles in one place together very infrequently over the course of a planning study. It is the PDT that meets together regularly over the course of a study. Some of those meetings will be to accomplish specific planning tasks. For example, there will be scoping meetings, formulation meetings, and decision meetings. In between, there will ordinarily be many team meetings moving the planning study and the planning process forward. Over the course of a study, there will be good meetings and bad meetings. Bad meetings seem to last forever, everyone seems to be posturing or griping, and the meeting never seems to get to the point if the point was ever clear at the beginning. You leave the meeting wondering why you were there. A good meeting, by contrast, leaves everyone energized, with a feeling of accomplishment.

So what makes a good meeting? A good meeting:

- Has an objective and meets it
- Takes up a minimum amount of time
- Leaves participants feeling that a good process has been followed

How to Provide Feedback

- Make it a positive process and experience – Improve the situation or performance
- Be timely – Give feedback close to the events you address
- Prepare your comments – Be clear about you are going to say
- Be specific – Tell the person exactly what they need to improve on
- Criticize in private – Public recognition is appreciated, public scrutiny is not
- Use "I" statements – Give the feedback from your perspective
- Limit your focus – Discuss no more than two issues
- Talk about positives too – Start off with something positive
- Provide specific suggestions – Make sure you both know what needs to be done to improve the situation
- Follow up – To improve performance, you need to measure whether or not that is happening

Adapted from Mind Tools
https://www.mindtools.com/pages/article/newTMM_98.htm

Accessed July 14, 2016.

An effective meeting does not just happen; someone must plan it. An effective meeting serves a useful purpose; it achieves a desired outcome. A good meeting begins with a clear focus and clearly stated desired outcomes. Begin with the ending in mind. Tell people the purpose of the meeting and identify your desired outcomes. With the end in mind, it is easier to structure the meeting and assure your objectives are fulfilled.

Meeting Objectives

Is this a progress report, are you updating one another?

Is this a brainstorming meeting?

Are you formulating plans?

Are you sharing analytical results?

Are you making a decision?

A Good Agenda Considers

- Priorities – What absolutely must be covered?
- Results – What do you need to accomplish at the meeting?
- Participants – Who needs to attend the meeting for it to be successful?
- Sequence – In what order will you cover the topics?
- Who will lead each topic?
- Timing – How much time will be spent on each topic?
- Date and Time – When will the meeting take place?
- Place – Where will the meeting take place?

Adapted from https://www.mindtools.com/CommSkll/RunningMeetings.htm

Accessed February 5, 2016

Time is a precious resource for everyone, and no one wants to waste it. A 15-minute diversion for 8 people costs you 2 hours. If there are things that can reliably be done outside the meeting, do them outside the meeting. Use digital resources to share information that the team does not have to digest or discuss. Do not use team meetings to exchange information that can be more effectively exchanged in one-on-one conversations.

Once the meeting's objectives are set, everything that happens in the meeting should further those objectives. An agenda is an essential tool to keep the meeting running on target and on time. The elements of a good agenda are seen in the textbox.

To ensure a satisfying process, circulate the agenda to everyone involved and solicit input (did we leave anything out?) and feedback (is there anything we can remove from the agenda?). At the start of the meeting, it is useful to get a formal agreement on the agenda. This empowers you to return to the agenda if the meeting drifts away from it.

To Be the Best Team Leader

Do not think you can rely on your technical knowledge and skills to succeed as a team leader. You need to take the time necessary to develop people skills.

Do not fail to consult regularly with the vertical team in a misguided attempt to show the team can plan on its own.

Do not approach the vertical team without having thought a problem through and without having considered how the problem could be solved.

Do not embarrass any members of the vertical team or subject them to an unwelcome surprise.

Do not misuse your position. Make sure that everything you ask people to do is in the interests of the USACE and the communities for whom you plan.

Once the meeting has begun, the facilitator needs to keep the meeting on topic. All meetings need a facilitator, whether or not it is the study lead or PM or other team member. As each agenda item is finished, quickly summarize the outcome and ask the team to confirm that you have given a fair summary. Meeting minutes should reflect the summary and the agreement.

If people are wandering off topic, return to the agenda. When addressing an important topic, make a point of asking everyone for their ideas if the meeting size permits it. Learn

to read body language and make adjustments as needed. Use breaks strategically. Make a list of all follow-on tasks generated at the meeting and identify who is to do what by when. Before the meeting ends, quickly summarize its outputs and the next steps, let everyone know meeting minutes or a summary will be coming out, then follow through. Given the frustration most people feel when their time is wasted in unproductive meetings, gaining a reputation for running efficient and successful meetings is good for you and your career.

3.5 Vertical Team Risk Management

Water resource planning investigations are undertaken because of the existence of water resource related risks in the exposed communities of our nation. The completion of a planning study and the preparation of the Chief's Report provides a risk management response to the relevant risks addressed in the investigation. Preparing that report is the vertical team's primary risk management responsibility. The vertical team has the most influential role in determining tolerable levels of risk and recommending a course of action as a result of the planning process.

There is uncertainty in that planning process, and it is the vertical team's joint responsibility to address that uncertainty in an effective manner. This responsibility begins with the PDT, which has the primary responsibility for identifying the most significant uncertainties encountered in the study. The other levels of the vertical team have a responsibility to keep themselves informed about these uncertainties and to assist the PDT in managing the risks associated with these uncertainties. That means carefully communicating about uncertainty is an essential ongoing planning activity.

The PDT identifies high and medium risks to the study and to project implementation in the RR. It is the PDT's responsibility to identify risk management measures to address these identified risks. The other levels of the vertical team then concur with the risk management approach proposed or they modify it. The PDT implements the risk management measures. The other levels of the vertical team are responsible for monitoring the risk management results obtained by the PDT. If the desired effects are not being realized, it is the responsibility of the other levels to modify the study's approach to uncertainty and its resulting study execution and project implementation risks.

The RR is the primary means of communicating significant sources of uncertainty in the planning process and of identifying the study and implementation risks that arise from that uncertainty. Although the PDT prepares the RR, it must be owned by the entire vertical team. The RR is not simply a planning task; it is the vertical team's risk management tool. The vertical team is responsible for actively managing the high and medium risks identified in the RR. Because the PDT produces the RR, it is incumbent upon the other levels of the vertical team to actively monitor the risk management efforts of the PDT. Are the desired study and project results being realized? If not, the vertical team should modify the study approach to manage the risks more carefully.

3.6 Five Points to Take Away

Here are five key points to take away from this chapter.

1. Transdisciplinary teams are better than interdisciplinary teams, which are better than multidisciplinary teams.

2. The project delivery team is the heart and soul of the USACE planning effort.

3. Good team meetings do not just happen; someone plans them.
4. The vertical team is jointly responsible for the USACE risk management responsibility in water resource planning.
5. The RR is the vertical team's primary risk management tool.

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Chapter 4
Introduction to Risk

"I have heard there are troubles of more than one kind. Some come from ahead some come from behind." — Dr. Seuss, The Lorax

4.1 Introduction

Uncertainty gives rise to risk. Risk is a measure of the probability and consequence of uncertain future events. It is the chance of an undesirable outcome. At times, risk has been defined by the following simple equation:

Risk = Consequence x Probability

This is not a literal formula for calculating risks; most risk calculations are more complex. It is an informative mental model that identifies two essential elements of a risk. The multiplicative form of the equation says if a consequence has no probability of occurring, there is no risk. Likewise, no matter how probable an event, if there is no consequence, there is no risk.

USACE faces two broad categories of risk—risks of loss and risks of unrealized gains. A risk of loss is called a pure risk, and it could be a loss due to flood, storm damage, infrastructure failure, disruption of project services, bad weather, economic setbacks, or any sort of hazard. These losses include loss of life, health and safety, property damage, structural integrity, environmental degradation and loss, loss of ecosystem services, loss of transportation services, and so on. The risk of an unrealized gain is called a speculative risk. Examples of potentially unrealized gains include:

- Transportation cost savings that do not occur
- Cost reductions that do not occur
- Ecosystem restoration benefits that do not materialize
- Operation and maintenance efficiencies that are not realized
- An investment that does not produce the expected recreation benefits, water quality improvements, and the like

It is important for planners to be able to differentiate the nature or status of a risk by recognizing the following kinds of risk:

- **Existing risk** – The risk that exists now
- **Future risk –** A forecast of a risk at some point in the future, for example a without or with condition risk
- **Historical risk** – A risk that was present at some point in the past

- **Risk reductions** – The extent to which an existing, future, or historical risk is or might be reduced by a plan
- **New risks** – A risk that did not previously exist
- **Residual risk** – The amount of existing, future, or historical risk that remains or might remain after a plan has been implemented
- **Transferred risk** – A reduction in risk at one point in time or space for one kind of event or activity that increases risk at another time or space for the same event or activity
- **Transformed risk** – The nature of a hazard/opportunity or a population's exposure to that hazard/opportunity has been altered

Planners need to think comprehensively about risk and that begins by identifying the relevant risks encountered in the planning process.

4.2 Identifying Risk

The problems and opportunities identified in the planning process are going to be risks. Thus, it is important that planners be able to identify a risk. There are five essential steps to a good risk identification process:

1. Identify the trigger event
2. Identify the hazard or opportunity for uncertain gain
3. Identify the specific harm or harms that could result from the hazard or opportunity for uncertain gain
4. Specify the sequence of events that is necessary for the hazard or opportunity for uncertain gain to result in the identified harm(s)
5. Identify the most significant uncertainties in steps 1, 2, 3, and 4

Loss Risk

Trigger: Congressional authorization

Hazard: Aquatic nuisance species (ANS)

Harm: Reduced landings of commercial fisheries

Sequence: Pathway exists->ANS arrives at pathway->ANS survives passage thru pathway->ANS colonizes in commercial fishery waterway->ANS spreads and outcompetes commercial fishery

Uncertainty: Arrival time, survival through pathway, will it outcompete

Speculative Risk

Trigger: Competition among ports

Opportunity: Reduce transportation costs

Harm: Reductions not realized

Sequence: Harbor improvements-> fleet composition does not change-> tonnage lost to other ports

Uncertainty: Fleet composition, trade patterns, technology changes

Trigger. Something initiates a risk identification. It could be a discrete event like a study authorization or a flood, information obtained from stakeholders, the accumulation of scientific knowledge, an intentional search for risks, and the like. It helps to note the event that triggers a specific risk coming to light.

Hazard or Opportunity. A *hazard* is anything that is a potential source of harm to a valued asset. Hazards include all natural and anthropogenic events capable of

causing adverse effects on people, property, economy, culture, social structure, or environment. Hazards are expanded readily to include biological, chemical, physical, and radiological agents. Examples of hazards include floods; aquatic nuisance species; hazardous, toxic and radioactive waste (HTRW) sites; seismic events; hydraulic fracturing; and so on.

An *opportunity* is any situation that causes, creates, or presents the potential for an uncertain positive consequence. It is any set of circumstances that presents a good opportunity for progress, advancement, or other desirable gain to a valued asset. The gain may be personal, communal, societal, national, or global. The USACE is primarily engaged with opportunities for ecological, economic, and financial gain. Opportunities include transportation cost savings, reduced lockage times and wait times at locks, reduced operation and maintenance costs, water quality improvements, increased habitat units, and so on.

Harm. Determining the specific harm in a risk situation must precede an assessment of the probability of that harm. Thus, consequence comes before probability in the risk identification task. If one begins with the probability, it is easy to become confused: the probability of what? Once the consequence is identified, it is easier to identify its probability. Planners must identify the specific harm or harms that can result from a hazard. Likewise, they must identify the disappointing and unwelcomed results that can occur with an opportunity for uncertain gain.

There may be more than one undesirable outcome. If so, identify all the relevant harms to be assessed. Floods for example can result in loss of life, property damage, business loss, and other kinds of harm. Ecosystem restoration could increase habitat, improve water quality, increase ecosystem services, and offer other potential gains.

Sequence of Events. For each harm identified, the planner should identify the specific sequence of events that is necessary for the hazard to result in the identified harm. The likelihood of that precise sequence of events occurring will define the probability of the risk. When there is more than one pathway from the hazard to the harm, each relevant pathway ought to be identified. In a similar fashion, the sequence of events from an opportunity to an undesirable outcome ought to be identified.

Uncertainty. The initial identification of a risk is likely to be highly uncertain. The potential for some consequences, i.e., harms, may be poorly understood and the sequence of events that leads to them may, likewise, be ambiguous. Even when the consequences and their causative events are known, there will be uncertainty about their magnitude, frequency, duration, and the like. It is the planner's job to identify the most significant uncertainties that attend a risk.

The problems and opportunities identified in a good planning process are nothing but risks. Hence, the risk identification process is a useful way to flesh out the nature of a study's problems and opportunities.

4.3 Acceptable and Tolerable Risk

In a risk-informed planning process, risk in some form is going to be a decision criterion. This may require little more than a subtle and nuanced shift in perspective. For example, expected annual damages, a risk metric, have long been a critical decision criterion for flood risk management studies. In other instances, new risk metrics may be introduced into planning's evaluation,

comparison, and selection tasks. Considering risk metrics in decision processes requires us to consider some explicit risk terminology, specifically acceptable, unacceptable, and tolerable levels of risk.

A risk is acceptable when its probability of occurrence is so small, its consequences are so slight, or its benefits (perceived or real) are so great that individuals or groups in society regard them as insignificant and adequately controlled. A risk that is not acceptable is unacceptable by definition. Planners ultimately have to consider whether an assessed risk is acceptable or not. This is a subjective judgment, not a scientific determination. A risk that is judged acceptable requires no risk management. A risk that is unacceptable should be managed.

Speculative Risks

An acceptable or tolerable level of speculative or opportunity risk looks a little different. An acceptable speculative risk is one with a negligible probability of a negative outcome or with positive consequences so large that it offsets the chance of a negative outcome. Alternatively, the negative consequences may be so slight that individuals or groups in society are willing to take the risk. Investing in a project that has zero chance of negative net environmental benefits might be an example of an acceptable risk.

A tolerable opportunity risk is one that decision makers or society are/is willing to take. Risk-taking is essentially different from risk avoidance. Risk-taking decisions are conscious decisions to expose oneself to a risk that otherwise could have been avoided.

It is conceptually possible for a plan to reduce an unacceptable level of risk to an acceptable level. More often than not, unacceptable risks are reduced to tolerable levels. A tolerable risk is not an acceptable risk. It is a non-negligible risk that has not yet been reduced to an acceptable level. Such a risk is tolerated for one of three general reasons: it may be impossible to reduce the risk further, the costs of further reduction are considered excessive, or the magnitude of the benefits associated with the remaining risky activity are too great to reduce it further.

A tolerable risk is an unacceptable risk whose severity has been reduced to a point where it is tolerated. Protection from flows equal to or less than the 1 percent exceedance frequency flow might be an example of a tolerable level of risk. Is it acceptable to be flooded by a flow with an exceedance frequency of 0.5 percent? Absolutely not! That flooding may be tolerated, however, because the cost associated with further reductions in flood risk were considered excessive. It would be far better to be *flood-free*, but that is not a viable option, so communities must tolerate some level of residual risk.

Ultimately, planners will have to ascertain whether a risk is acceptable or not. If it is not acceptable and it cannot be reduced to an acceptable level, planners will have to determine what the affected stakeholder groups' tolerable level of risk is.

4.4 Risk Management in USACE

Risk analysis is a process that has evolved specifically for decision-making under uncertainty. It consists of the three tasks: risk management, risk assessment, and risk communication as shown in Figure 4.1.

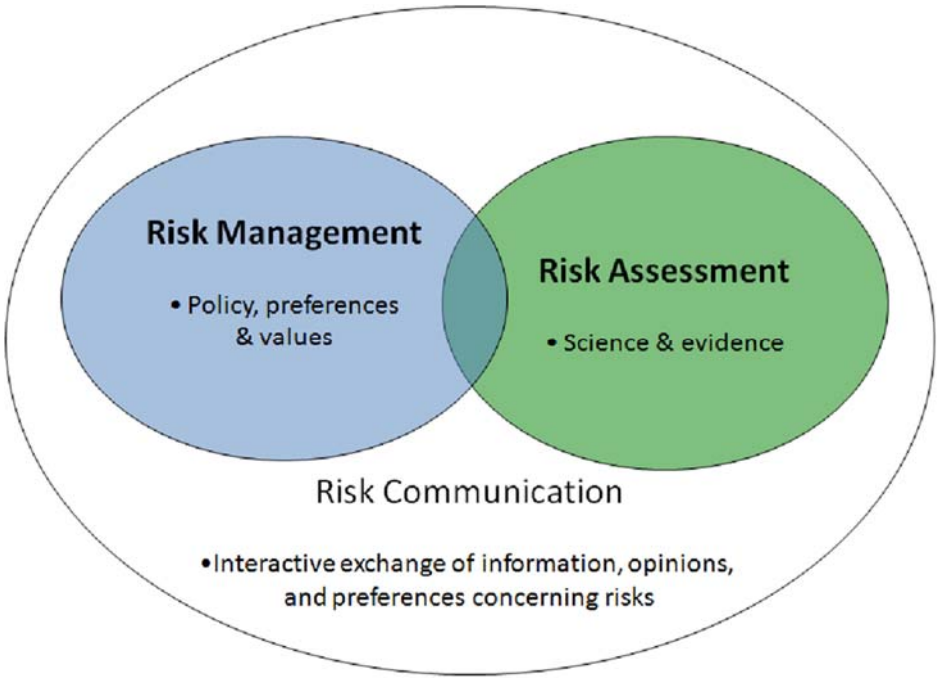

Figure 4.1: Risk analysis comprises risk management, risk assessment, and risk communication

The USACE prefers to use risk management as the overarching concept that is inclusive of the same three risk tasks. The USACE risk management process can be described by the model in Figure 4.2, which includes assessment and communication. Risk-informed planning incorporates the USACE risk management framework into the USACE planning process.

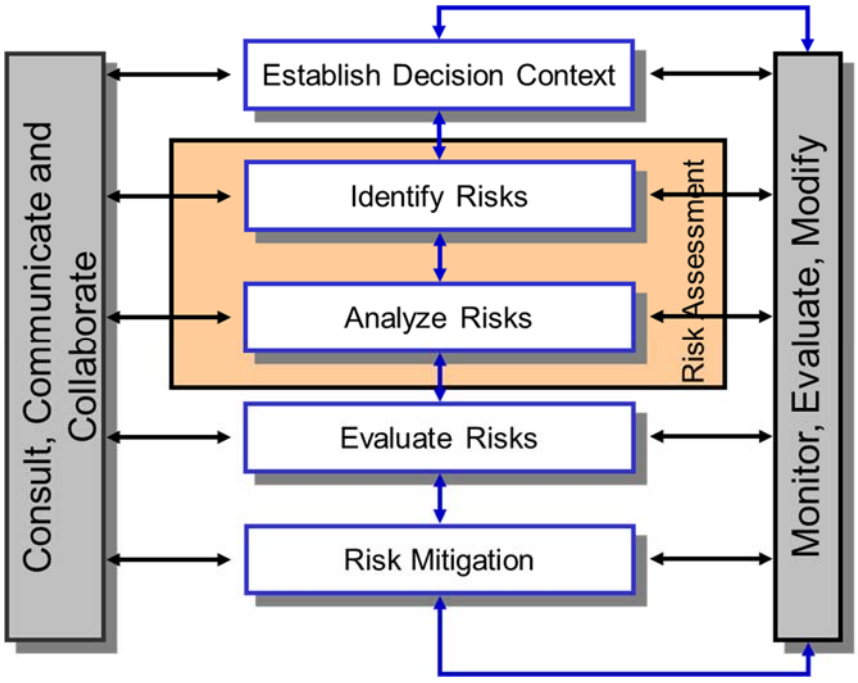

Figure 4.2: The USACE risk management model

The risk-informed planning model is reproduced in Figure 4.3, with the steps of the risk management model overlaid to show where in the risk-informed planning process they would be accomplished.

Figure 4.3: The USACE risk-informed planning process integrated with the USACE risk management model

The risk management tasks of Figure 4.2 map into the planning tasks of Figure 4.3 as shown in Table 4.1. Thus, risk-informed planning embodies all the principles and tasks of the USACE risk management process as well as the six steps of the planning process.

Table 4.1: Mapping the USACE risk management model into the USACE planning model

Planning Task/Process	Risk Management Task Included
Scoping	Establish Decision Context Identify Risks
Evidence Gathering	Analyze Risks Evaluate Risks
Plan Formulation	Evaluate Risks
Deciding	Evaluate Risks
Implementation	Risk Mitigation Monitor, Evaluate, Modify
Stakeholder Engagement	Consult, Communicate, and Collaborate

4.5 Risk Assessment

Risk assessment is a systematic process for qualitatively or quantitatively describing risks. It includes the tasks that gather the evidence, answer the risk manager's questions, and identify and address the uncertainty that remains about the risk. The risk assessment process is defined by the four-step model in Figure 4.4; it is broad enough to cover both pure and speculative risks.

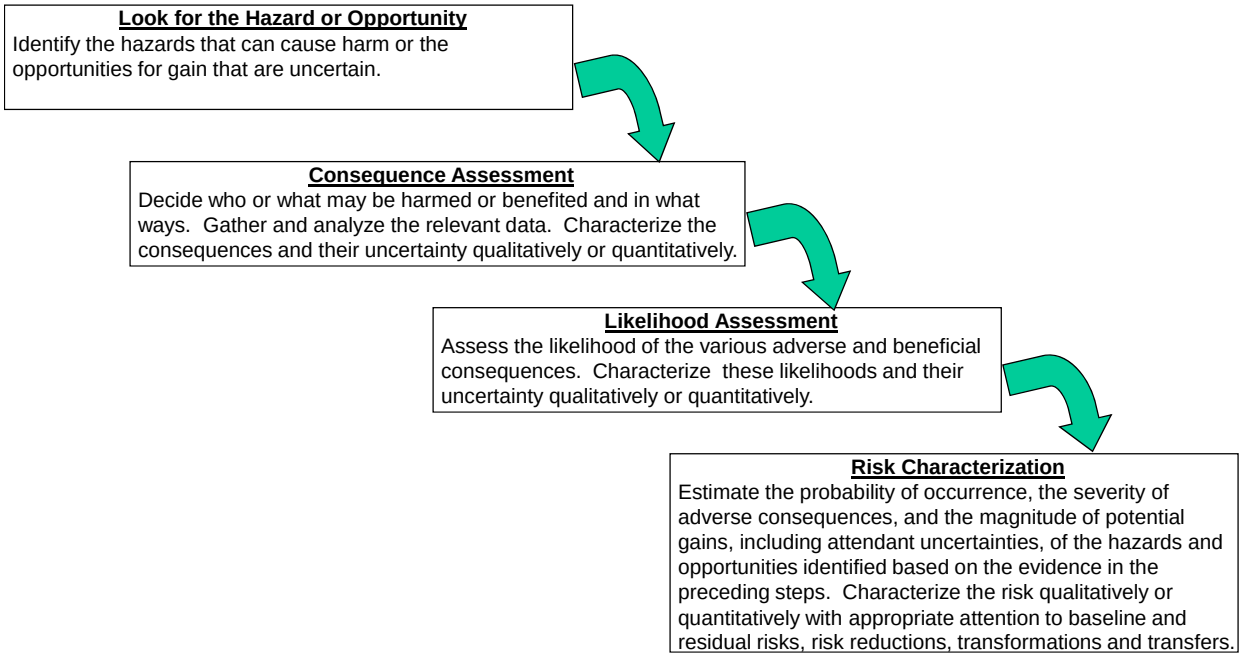

Figure 4.4: A generic four-step risk assessment process

Risk assessment fills in the details of the risk identification process. The first step simply requires a clear identification of the source and nature of the risk. What is the hazard that threatens a loss or the opportunity that promises a gain? The next two steps require the assessor to assess the consequences of the specific risk and the likelihood of those consequences occurring. The final step, risk characterization, is where the analysis of the three preceding steps is pulled together to characterize the risk qualitatively or quantitatively for the purpose of supporting decision-making. Throughout this process, the USACE analyst is to carefully consider and address the uncertainty at each stage of the assessment, most importantly in the characterization of the risk itself.

4.6 Risk Communication

Risk communication is the open, two-way exchange of information and opinion among risk analysts, their stakeholders, and various publics about risks. This exchange is intended to lead to a better understanding of the risks and improved risk management decisions.

Three common risk communication goals, relevant to USACE risk communications with interested parties, are (Food Insight 2010):

1. Tailor communication so that it takes into account the emotional response to an event.
2. Empower the audience to make informed decisions.
3. Prevent negative behavior and/or encourage constructive responses to crisis or danger.

In USACE, risk management is recognized as an important responsibility. It is not yet an occupation category. Risk managers may not even know they are risk managers. All risk managers are decision makers. Decision makers who are not directly engaged in mainstream risk management activities are not likely to think of themselves as risk managers despite their risk management responsibility in the decision chain. We distinguish decision makers from risk managers here, based on their limited direct involvement in risk management activities. Thus, a district Engineer or an Assistant Secretary of the Army is more decision maker than risk manager despite their risk management responsibility.

USACE risk communicators need to pay special attention to describing all the relevant dimensions of a risk. Risk communication does not require consensus or agreement among all parties. However, it should provide people with meaningful opportunities for input before decisions are made and for feedback as evidence is accumulated and uncertainty is reduced. Risk communication requires listening to and understanding people's concerns about risks so that those concerns can be considered during decision-making. This is essential if the public is to respect the planning process, even if they disagree with some of its decisions and outcomes.

4.7 Planning Process Risks

Study Risk Choices

Imagine a study with five alternative plans. Cost estimates are needed for each. Five options for estimating costs are: arrange the plans from least to most expensive; use parametric cost estimates; or use 5, 10, or 20 percent levels of design detail.

To use an ordinal ranking invites the risk of making a poor screening decision. To use 20 percent design detail estimates on all five plans would consume resources that could be used to reduce other uncertainties.

Risk-informed planning is especially concerned with risks in the study area, risks that arise while conducting the planning study, and outcome risks. Problems or risks identified in the study area routinely are addressed by the risk-informed planning process described in this manual. These risks are the reasons a planning investigation is undertaken. Planning has always been a kind of risk management process; it is only now that it is described as such.

Risks can arise because of the way a planning study is conducted. There will not be enough data, time, money, or expertise to do all the analysis the USACE vertical team would prefer to have done. Thus, choices must be made in how to expend the available study resources in order to reduce uncertainty to manageable levels of risk. Choices about what data to gather, what analysis to perform, and the like can create risks of study delays, cost overruns, errors in analytical work, and possibly bad planning decisions. Uncertainty during the planning process could lead to errors in judgment that could affect the cost and timing of completing a project. These study risks are routinely handled through the SMART planning practices outlined in Chapter 2.

Outcome risks describe the risks that will result if the recommended plan is implemented. At the feasibility level of planning, there is likely to be some uncertainty about the extent to which the recommended plan will be able to meet the planning objectives. Even when project performance uncertainty is negligible, there will always be some residual or retained risks associated with the recommended plan. Residual risks, in particular, need to be carefully estimated and narrated. In addition to these two classes of outcome risk, there can be new, transformed, or transferred risks associated with any new risk management measures or recommended plan features. These risks ought to be identified in at least a qualitative risk assessment of the TSP. The other outcome risks will be addressed through USACE life cycle risk management model. As the recommended plan moves out of feasibility planning into the preconstruction, engineering, and design (PED) part of its life cycle, the carefully identified outcome risks move with it.

The PDT identifies the TSP. That plan must be subjected to public and agency review (of the draft feasibility report) and optimized before it can be identified as the recommended plan in the final report. Significant changes to the TSP, or selection of a completely different plan, may occur prior to the final report. PED starts with approval of the recommended plan.

Olmsted Lock and Dam provides a good example of an implementation risk. The Olmsted Lock and Dam project was authorized by Section 3(a)(6) of the Water Resources Development Act of 1988 at an estimated cost of $775 million. The project was reauthorized in Public Law No: 113-46 of 2013 at an estimated cost before inflation of $2.918 billion. The project is cost shared 50/50 with the Inland Waterways Trust Fund. Restrained annual funding, inflation, river conditions, and a low initial dam cost estimate have contributed to the construction costs.

4.8 Five Points to Take Away

Here are five key points to take away from this chapter.

1. *Risk = Probability x Consequence* is a handy conceptual model of risk.
2. USACE faces two kinds of risk: pure risk (loss to avoid) and speculative risk (opportunity for uncertain potential gains).
3. Good risk identification consists of a trigger, hazard, harm, sequence of events, and uncertainty.
4. Risk-informed planning incorporates the USACE risk management model into the USACE planning model.
5. Risk-informed planning addresses study area risks, study risks, and outcome risks.

4.9 References

Food Insight. (2010). *Risk Communicator Training for Food Defense Preparedness, Response & Recovery: Trainer's Overview*. Accessed May 15. http://www.foodinsight.org/Resources/Detail.aspx?topic=Risk_Communicator_Training_for_Food_Defense_Preparedness_Response_Recovery.

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Chapter 5
Uncertainty

"The more that you read, the more things you will know. The more that you learn, the more places you'll go." — Dr. Seuss, I Can Read with My Eyes Shut

5.1 Introduction

If planning is thinking carefully about the future and how best to get to the most desirable future from the present, then it is fundamentally an exercise in uncertainty because the future would be the dictionary picture of uncertainty if there was one. To understand planning, one needs to understand uncertainty. The planning process is, to a great extent, an analytical exercise in rationally reducing uncertainty. Risk-informed planning addresses uncertainty intentionally, throughout the planning process, so this chapter begins by describing what it means to be intentional about uncertainty. There are many ways to slice and dice the concept of uncertainty, and this chapter introduces four of them.

Uncertainty needs to be a thread in each planning step as do risks.

What do we do to identify uncertainty in each step?

What do we do to reduce uncertainty in this step?

How do we handle it in each step?

What do we do to communicate uncertainty in each step?

Uncertainty occurs at two distinctly different levels of resolution. There is macro-level uncertainty that involves social values and accounts for the uncertain environment in which planners plan, and there is the micro-level uncertainty that occurs at the level of the planner's desktop. These levels of uncertainty present distinctly different challenges to the USACE planner.

The knowledge and meta-knowledge conundrum, popularized by Donald Rumsfeld, provides a convenient platform for focusing the discussion of uncertainty on what we do and do not know. This provides an entry into the third and perhaps most practical distinction for planners: the nature of our uncertainty. If we are not sure about any aspect of our planning work, then we are uncertain. In general, uncertainty derives from one of two sources. There can be knowable facts that we, for any reason at all, may not know. This source of uncertainty is called knowledge uncertainty. Other times the variability inherent in the universe may prevent us from knowing a value even when we have sufficient data and facts. This source of uncertainty is called natural variability.

There is a fourth way to categorize uncertainty that is important to planners. First, planners can be uncertain about the issues that gave rise to the planning study, i.e., they may be unclear about the problems and opportunities or what success should look like. Second, they may be uncertain about how best to conduct the study itself. Finally, there may be some uncertainty about what the outcomes of an implemented study will be. Each of these uncertainties is considered.

Uncertainty gives rise to risk. Without uncertainty, there is no risk. Because planning is replete with uncertainty, risk-informed planning is essential. The purposes of this chapter are to help planners learn to:

- Emphasize the importance of addressing uncertainty in a rational and intentional manner
- Distinguish the two levels of uncertainty
- Distinguish the two sources of uncertainty

5.2 Being Intentional About Uncertainty

The biggest difference between the planning methodology described in this manual and the original *Planning Manual* is the manner in which uncertainty is intentionally addressed throughout the planning process. Risk-informed planning is intentional about uncertainty. Throughout this manual, there are repeated references to uncertainty and to the need to intentionally address that uncertainty. Here are nine actions to take to become intentional about uncertainty in decision-making:

1. Recognize that uncertainty exists in your decision problem.
2. Identify the specific things that are uncertain and the sources of that uncertainty.
3. Identify those uncertainties that are important to your decision problem. These are the uncertainties that have the potential to have a significant effect on your decision criteria.
4. Acknowledge this significant uncertainty and make stakeholders aware of its existence.
5. Choose appropriate tools and techniques to address each significant source of uncertainty.
6. Complete your analysis incorporating these tools and techniques.
7. Understand the results of your analysis.
8. Identify any options for further reducing the remaining uncertainty.
9. Convey your results, the significance of the uncertainty, and any options for reducing uncertainty to decision makers.

These steps can be applied in scoping, formulation, screening, implementation, evidence gathering, and public involvement. Now, let us take a more careful look at this notion of uncertainty.

5.3 Two Levels of Uncertainty

Planners need to be able to distinguish uncertainty at the macro-level of their work from the uncertainty at the micro-level of their work. The former is generally more difficult to address than the latter.

5.3.1 Macro-Level Uncertainty

Uncertainty is an emerging constant in modern decision-making. We all operate in an uncertain environment. Growing social complexity and an increasingly rapid pace of change are now permanent parts of the decision-making landscape. The size of a society, the number of its parts, the distinctiveness of those parts, the variety of specialized social roles that it incorporates, the number of distinct social personalities present, and the variety of mechanisms for organizing these into a coherent, functioning whole have grown immensely over the last century (Tainter 1996). We live in societies with millions of different roles and personalities. Our social systems are so complex that they often defy understanding. One need only try to identify USACE partners, stakeholders, and publics in a planning study to begin to understand this social complexity. USACE no longer answers only to Congress. As a direct consequence of this complexity, USACE problem solving methods have grown more complex.

Now, add to this complexity the increasingly rapid pace of change in almost every arena of life. Scientific breakthroughs make things once impossible to conceive commonplace. Much of this change is driven by rapid advances in technology. Technology changes social values and beliefs as well as the way we live and work. The ways we communicate have changed forever and continue to change in ways that are difficult to forecast. Change is too rapid and at times too turbulent to be wholly understood or predicted. This challenges USACE and its traditional programs. Large public works projects built in decades past in response to values long since changed or evolved challenge USACE to keep pace with the changes that affect them, especially when national priorities have changed drastically since these projects were constructed.

Social, economic, and technological connectivity around the globe accelerates at a dizzying pace. Social movements are often global in their pervasiveness. We are increasingly a global economy. Fashions are designed in New York and approved in London, patterns are cut in Hong Kong, clothes are made in Taiwan and shipped in containers on vessels that call around the world, and then the clothes are sold across Europe and North America. Computer viruses spread in hours; human viruses spread in weeks. We are indelibly connected.

With government deficits and debts rising in the more established economies of the world, there is relentless pressure on costs in all public decision-making. Patterns of competition are becoming unpredictable. Customer demands grow increasingly diversified. There is a growing role for one-of-a-kind production. Rapid sequences of new tasks in business and government are becoming more routine. Transportation patterns shift, modes of transport change, priority projects are quickly displaced, and budget commitments are unpredictable.

These and other changes present USACE with a world where irreversible consequences unlimited in time and space are now possible. Many of the problems USACE planners face can have a long latency period. Many of our country's landscape scale ecosystem restoration problems like those in the Columbia River basin, Puget Sound, Florida Everglades, Coastal Louisiana and the Chesapeake Bay, as well as global concerns like invasive species, greenhouse gases, climate change and sea level rise, provide clear examples of problems that took decades to emerge and be recognized. The implications of the solutions being formulated may likewise take decades to be understood.

Public perception is a palpable force. In some situations, it is an irresistible one. Uncertainties and the risks they give rise to have a social context. Without social and cultural judgments, there are no risks. Nonetheless, these social and cultural judgments are not always grounded in fact. Unfortunately, they are also not always adequately considered in decision-making processes. The public is fond of equating the possibility of an undesirable outcome with the probability of such an outcome. This makes conceivable risks seem very possible, and it fuels our fears of the uncertain. It leads, paradoxically, to audiences that are alternately outraged and indifferent about the risks they face.

An oil spill in the Gulf of Mexico reverberates around the world. Flood problems grow worse, ecosystems degrade, invasive species threaten ecosystems, ports compete with one another for survival, and maintenance is deferred on critical infrastructure. Responsibility in this more connected world has become less clear. Who has to prove what and what constitutes proof under conditions of uncertainty? What norms of accountability are being used and to whom are we accountable? Who is responsible morally and who is responsible for paying the costs? These questions plague decision makers nationally and transnationally.

USACE planners live and operate in this uncertain reality. Social values are formed, changed, and re-formed against this backdrop of macro-level uncertainty. There are so many social relationships it is difficult to know what values the nation, a project area community, or a stakeholder group holds dear at any one point in time. Into this changed and changeable environment, the USACE planning process intrudes. A *culture of uncertainty* is required to survive in such an environment, and risk analysis provides just such a culture, thus, the evolving interest in risk-informed planning process.

5.3.2 Micro-Level Uncertainty

It is not the macro-level priorities of Congress, global geopolitics, values of a city's population, or climate change that command most of the attention in a planning investigation. Neither is the uncertain environment in which USACE plans the most pragmatic challenge for the USACE planner. Instead, it is the uncertainty that planners, analysts, and decision makers deal with every day on their jobs that most challenges the planning process. It is lack of data, incomplete theory, an absence of facts, imperfect models, unknown values, and the inherent variability of the universe that present the most immediate challenges to planners. These are the substance of micro-level uncertainty.

Rarely do USACE planners have all the information they need to estimate the effects of their plans in an accurate and precise way. Despite planning's reliance on the best available science and evidence, there is always a *pile of the things* we do not know. Being intentional about uncertainty enables experts to sort through that pile of things we do not know to better understand the nature and causes of the uncertainties USACE faces. The nature and cause of the uncertainty dictate the most appropriate methodologies, tools, and techniques to address it in a risk-informed planning process.

5.4 Knowledge and Meta-Knowledge

In February 2002, then Secretary of State, Donald Rumsfeld, while answering questions about weapons of mass destruction at NATO headquarters in Brussels, articulated the challenge of dealing with uncertainty in a way that, at first, drew laughter but that now draws our attention to the

challenge. Figure 5.1 illustrates the essence of his remarks. On the vertical axis, we have the state of our knowledge about a situation. On the horizontal axis, we find meta-knowledge, which can be described as our awareness of the limits of our knowledge.

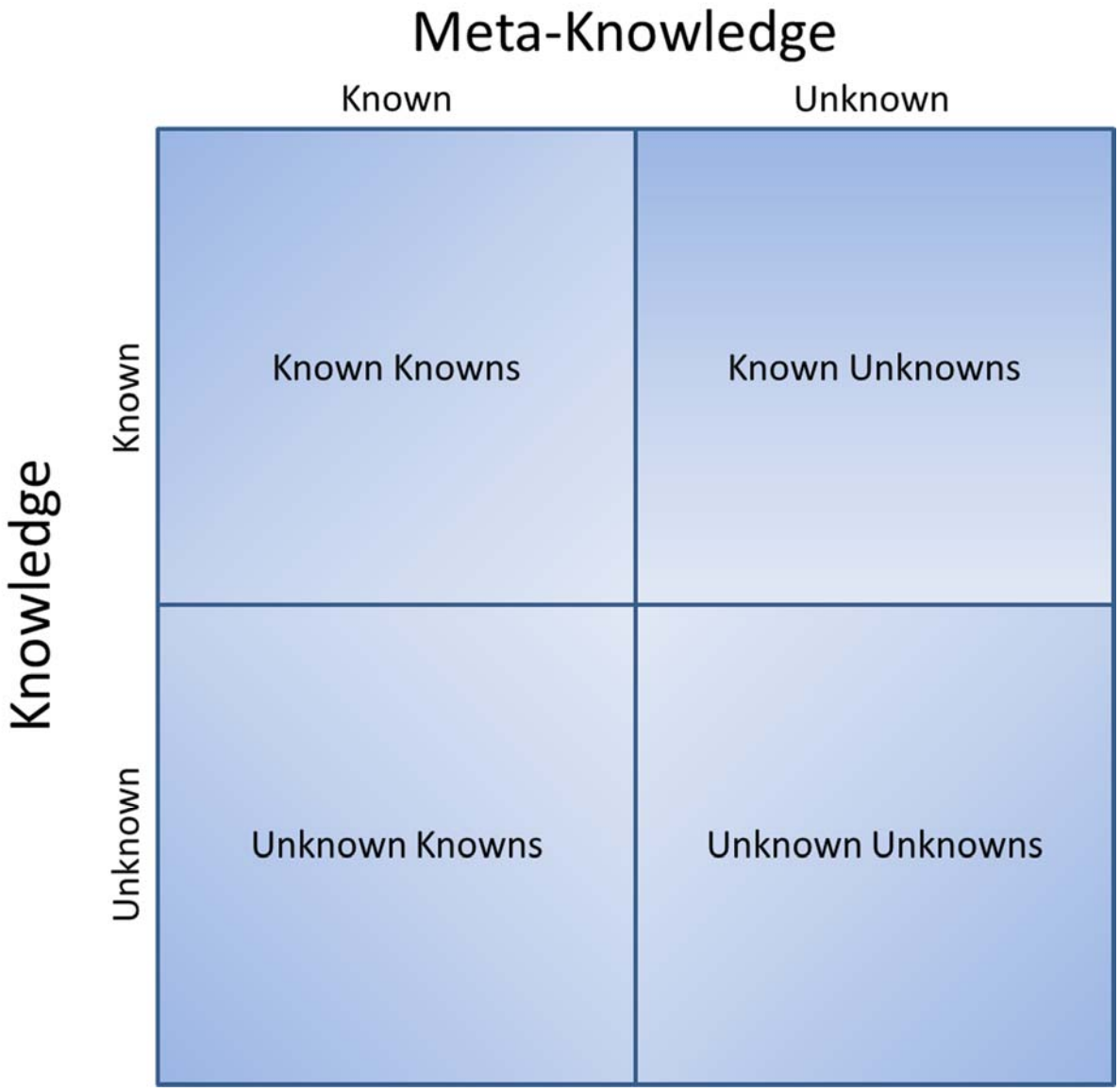

Figure 5.1: Rumsfeld's challenge of uncertainty

The axes describe four quadrants that planners encounter. In the upper left are the things that we know we know. In most situations, USACE will have accumulated knowledge of relevant facts. In these situations, routine decision-making processes are both appropriate and sufficient. In the lower left are things we know but we do not realize we do or can know them. Examples include the organizational knowledge that exists in the mountains of inspection reports, flat files, and accumulated wisdom that may not yet have been collected, organized, shared, and used. The USACE has geographically widespread resources and knowledge as well as accumulated expertise that has not been fully exploited. Project inspection reports, dredging records, contract prices, and the like,

accumulated over many years, hold a wealth of information that could be harnessed for use in planning studies as well as in infrastructure operation and maintenance strategies. These are unknown knowns, waiting for knowledge management techniques to reveal their gems of wisdom.

In the upper right are the things we know we do not know. These are the uncertainties that occupy most of the planner's time. These are the focus of SMART Planning strategies. They include the holes in our knowledge, the gaps in our data, and the shortcomings of our models of which we are aware. Lastly, in the lower right we find the things that we do not even know we do not know. These can provide the basis for study outcomes that differ markedly from the intended and expected outcomes. Over time, risk-informed planning hopefully will make inroads on those areas of unknown knowledge.

5.5 The Two Sources of Uncertainty

Uncertainty, as used in this manual, comprises knowledge uncertainty and natural variability. It is essential that any planner intent on reducing uncertainty be able to distinguish knowledge uncertainty and natural variability.

5.5.1 Knowledge Uncertainty

Knowledge uncertainty is uncertainty attributed to a lack of knowledge on the part of the observer. It stems from a lack or incompleteness of information. It is reducible in principle although it may be difficult or expensive to do so. Knowledge uncertainty arises from incomplete theory, incomplete understanding of a system, modeling limitations, and/or limited data. It also includes being wrong, for example, when we think a quantity has one value but it actually has another.

Examples of knowledge uncertainty abound in USACE planning. Planners may not know if there are cultural resources in the footprint of a plan or they may not know if HTRW are present in that same footprint. Will a plan have negative impacts on water quality? Are there endangered or threatened species in the project area? What is the number of houses in the 1-percent-annual-chance-floodplain? What is the largest ship to have used this port's channel? What is the most commonly shipped commodity on this waterway? How much will the combined flood risk management measures reduce the water surface profile? Will an electronic barrier succeed in preventing the passage of aquatic nuisance species? There is a general lack of experimental data to characterize new engineering materials and processes. Sometimes there is a poor understanding of the linkages between inputs and outputs in an ecosystem restoration project. Cost estimators may not know the value of land or the mean structure value in a floodplain. Early in a study, the number of utilities crossing a channel to be enlarged may be unknown. The value of Manning's roughness coefficient, the mean high daily temperature of water, the presence of cracks or spalling concrete in a monolith, toxin concentrations in sediments to be dredged, the extent of hard bottom affected by a navigation channel enlargement, and homeowner preferences for relocation out of the floodplain are all examples of knowledge uncertainty. These all have an important characteristic in common. There is a true and constant value[3] for each of these examples. These are questions that have answers. Other

3 True value as used in this chapter refers to a simple numerical or non-numerical fact. You may be unfamiliar with a specific dam and not know how many tainter gates it has. If, in fact, it has five tainter gates, five is the true value. A USACE lake has an average number of daily visitors in a year. You may not know that number. Even if the data have never been collected and the number has never been calculated, there is still a true value for this statistic.

causes of knowledge uncertainty include dated, missing, vague, or conflicting information, incorrect methods, faulty models, measurement errors, and incorrect assumptions. Knowledge uncertainty is, quite simply, not knowing facts that are, conceptually, knowable.

5.5.2 Natural Variability

Natural variability is uncertainty that deals with the inherent variability in the physical world. It refers to true differences in attributes due to heterogeneity or diversity. Natural variability is often attributed to a random process that produces variability of a quantity over time and/or space or among members of a population. It can arise because of natural, unpredictable variation in the performance of the system under study. In principle, it cannot be reduced or altered by obtaining more information although more information may improve estimation of the natural variability that exists. For example, a larger sample will provide a more precise estimate of the standard deviation, but it does not reduce variability in the population itself.

The USACE works with complex natural and manmade systems that are rife with examples of natural variability. The time to complete a lockage cycle or to move from point A to point B on a waterway, the number of barges in a tow, the draft of the next vessel, the peak annual flow on a stream, the price of a cubic yard of concrete over time, the magnitude of a flood, dissolved oxygen at different points on a stream, suitability of habitat for a species in a watershed, and the daily number of visitors to a lake are but a few examples. There is also variability in any attribute of a population, like the strength of the rebar in a concrete dam or the life of a lightbulb in the visitors' center.

Some quantities may entail both knowledge uncertainty and natural variability. Electric dispersal barriers are located in Romeoville, IL in the Chicago Sanitary and Ship Canal to deter the movement of invasive fish species between the Mississippi River basin and the Great Lakes. The number of fish that pass through these barriers in a month is not only unknown but it also varies from month-to-month. Thus, this quantity is subject to both sources of uncertainty.

There are some very practical reasons for distinguishing between knowledge uncertainty and natural variability. The first of these is that the choice of the most appropriate tool or technique for addressing uncertainty depends very directly on the source and nature of the uncertainty. Second, the effects of uncertainty in model outputs and decision criteria are characterized by intervals, probabilistic statements, or probability distributions; it is useful for assessors to know how much of the variability in the values is due to knowledge uncertainty and how much is due to natural variability. This information needs to be conveyed to decision makers so they can decide if additional effort to reduce uncertainty is warranted.

Consider Figure 5.2. It shows two hypothetical outcomes that measure a single decision criterion. The original estimate (dashed line) shows considerable variation in the values of the decision criterion. If the assessors of this value can attribute the variation to knowledge uncertainty and natural variability and communicate this to decision makers, they can then decide if it would be worthwhile to devote more resources to further reducing the knowledge uncertainty through data collection, research, or some other means. After doing so, the decision criterion can be re-estimated; imagine it is represented by the solid curve. Clearly, the uncertainty has been reduced as the distribution is now tighter.

Pleased with this improvement, the decision maker might desire additional reductions in uncertainty. However, if the remaining variation is due solely to natural variability, then there are

no options for further reducing the variation. The solid result may simply represent the true range of outcomes that is possible given the relevant natural variability in the system under consideration. It is impossible for either the assessor or the decision maker to know how much the decision criterion estimate can be improved unless the assessor can distinguish between the two sources.

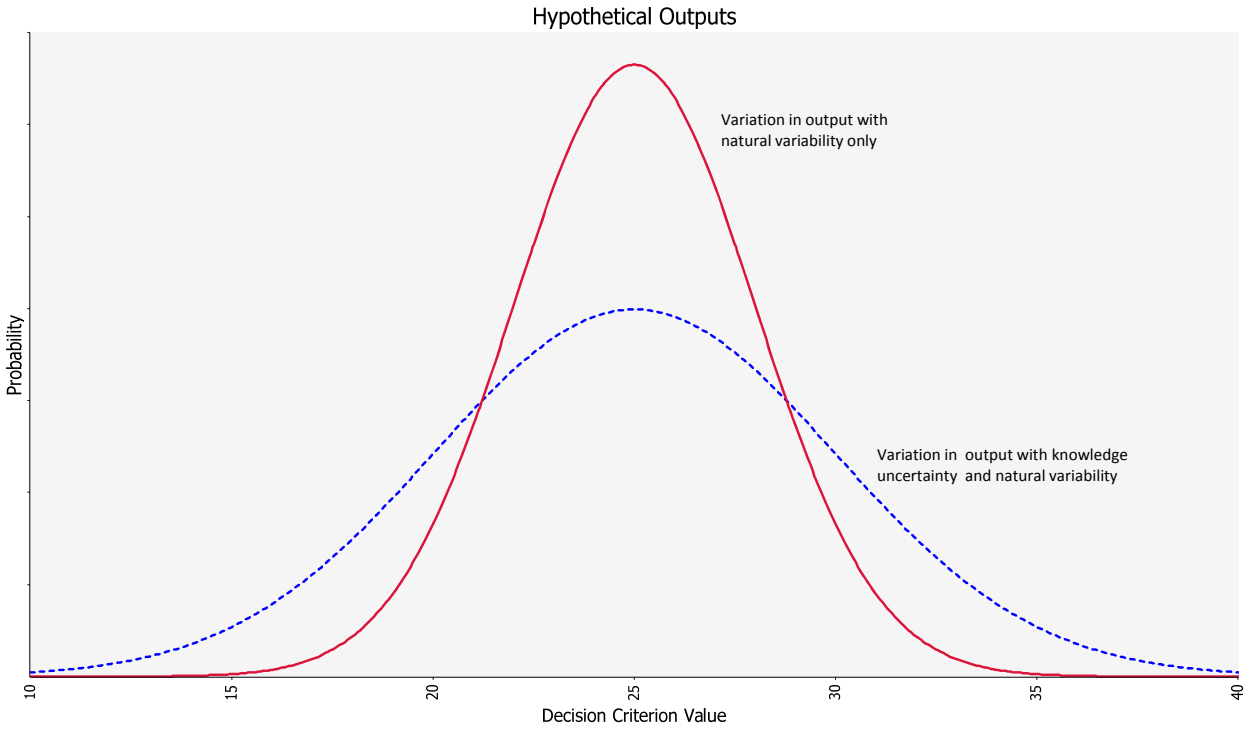

Figure 5.2: Two hypothetical distributions displaying uncertainty

5.6 Planning Uncertainty

It is time to talk about uncertainty in planning. It arises in three significantly different forms. Planners are uncertain about the issues in the study area that gave rise to the planning study. They may have little more than authorization language that refers to *flood risk and other purposes*. The start of a new planning study begins with a great deal of uncertainty about the risks that exist in the study area. The magnitude of the flood damage problem is likely to be uncertain as is the flood regime itself. Geotechnical conditions are often unknown as can be the quantity and quality of ecosystem services. The economic viability of a port may be a substantial uncertainty. Reducing the most important of these uncertainties in the existing and without project condition is essential to successful planning, and it requires a risk-informed planning process to do so.

These kinds of uncertainty are reduced during the conduct of the study itself. *The conduct of the study* introduces a second important source of uncertainty, study uncertainty. Depending on how a planning study is executed, it can result in analytical errors. Flawed assumptions can result in significant study delays, cost increases, or overruns. Perhaps the most serious risk arising from study uncertainty is the risk of a poor planning decision. This could mean expending resources on a

project that is not economically efficient or failing to invest in a project that is. A project may fail to adequately address the range of problems it is designed to correct.

This last example of a poor planning decision leads to the consideration of outcome uncertainty, which planners must also manage in their studies. The with project condition that leads to the outcomes of a plan are uncertain. Will a flood risk management plan produce the reductions in damages that are forecasted? Will it result in unintended consequences, e.g., project failure? If a new deep draft navigation project is constructed, will the forecasted commerce materialize and will real transportation cost savings be realized? In other words, will the project function as it is expected to function? Some of these outcome risks will depend on the extent to which the initial risks were properly understood. Some of these risks will depend on the efficacy of the planning study itself. The PDT should conduct at least a qualitative risk assessment of the TSP to pointedly consider the outcome risks associated with this new future. Implementation risks, like construction schedule delays and cost estimate overruns, are additional outcome uncertainties that planners must consider. Special emphasis is placed on these planning uncertainties throughout the remainder of this manual.

5.7 Five Points to Take Away

Here are five key points to take away from this chapter.

1. Planners must deal with two levels of uncertainty: macro-level and micro-level uncertainty.
2. Known unknowns and unknown unknowns are two distinctly different uncertainty challenges.
3. Uncertainty comprises knowledge uncertainty and natural variability.
4. The conduct of a planning study introduces a source of uncertainty to the planning process.
5. A risk-informed planning process is required to deal effectively with uncertainty.

5.8 References

Tainter, Joseph A. (1996). *Getting down to earth: Practical applications of ecological economics*. Washington, DC: Island Press.

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Chapter 6
Task One—Scoping

"Sometimes the questions are complicated and the answers are simple." — Dr. Seuss, Attributed Quote

6.1 Introduction

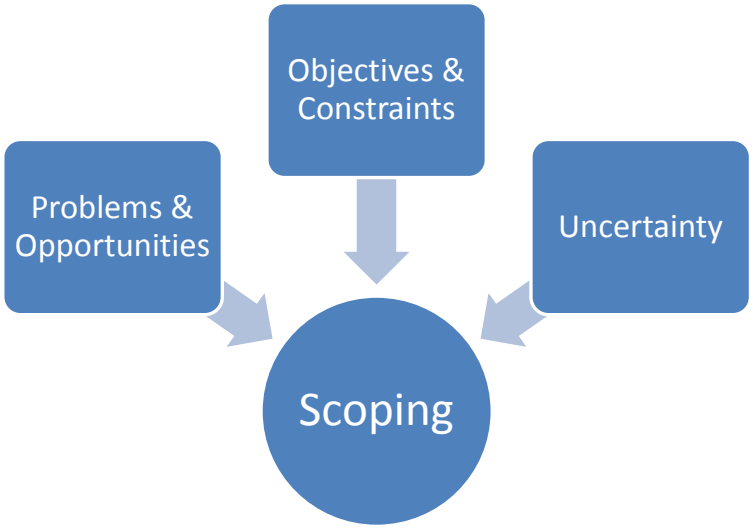

Figure 6.1: Three main tasks comprising the scoping task

You will never know less about your study than when it first starts. No matter how the planning process starts, it always begins with scoping the planning investigation. Figure 6.1 identifies the three most important foci of the scoping process.

The first of these is to get the problems right; if it is not, nothing else in the study is going to matter. At best, you may find a good solution to the wrong problem. Second, articulate for yourselves and others what a successful plan will accomplish; this is done through planning objectives and constraints. Third, think carefully about how uncertainty will be handled in the planning investigation.

Scoping a planning study brings the purpose of the study into focus. During the scoping process, planners decide what is and is not included in the study. This determines the complexity and focus of the study. A good scope provides a *road map* for how the study will be accomplished. The scope of a study provides the first formulation of the risks to be managed. It is essential that the vertical team and their stakeholders agree on the scope of the planning study. An agreement among principal parties on realistic expectations about study outputs, resource commitment, and timeframe is an additional benefit of scoping. Now, let us consider the work that must be done in the scoping task of planning.

6.2 Scoping Overview

It all begins with problems and opportunities. Figure 6.2 graphically summarizes the sequence of major activities in the first planning task. Each is introduced below and then expanded upon in its own section later in the chapter.

Scope and Range

Think of looking through a set of binoculars. Scope is analogous to the breadth of your field of vision; it defines what you do and do not see. Range is analogous to the depth of your vision; it defines the foreground and background.

Solving problems and realizing opportunities are the reasons for the planning study. This is the risk identification part of the study.

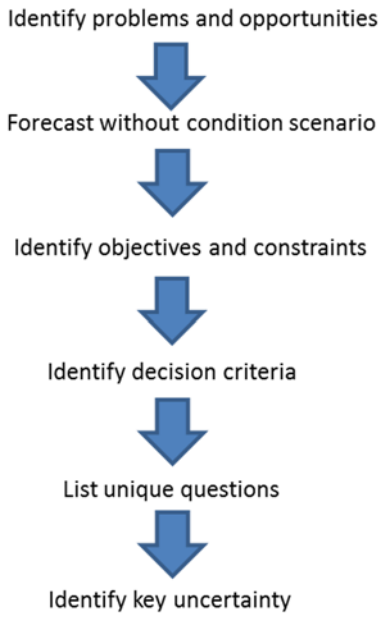

Figure 6.2: Scoping task activities

It is important to have a good idea what the study area will look like in the future if the study results in no federal action. This is the without condition scenario. It is the PDT's job to describe it. If that future is undesirable, there is a compelling reason to try to alter it.

The PDT and its stakeholders identify planning objectives and constraints that will lead to a more desirable future. What will a plan accomplish? What will it avoid doing? The planning objectives and constraints describe what a successful plan will accomplish; use them to guide all planning efforts.

There are many decisions to make along the way, and you will not have all the information you would like to have to make them. It is time to begin identifying the criteria that is expected to make those decisions, even if you are not sure of all of them. This is the only way to make sure the necessary data is collected, measure the right things, and do the necessary analysis in the weeks and months ahead. This is also when key uncertainties are identified.

When the planning study is routine or familiar, everyone knows what is expected of them. They can swing into action on day one because everyone knows just what to do. Other times, there are aspects of a planning study that may be new and unfamiliar to the PDT. In these unique situations, it is important to anticipate the unique kinds of information that will be necessary for decision-making. This could include information that goes well beyond decision criteria, e.g., new areas of inquiry, new kinds of investigations, or unique subject matter expertise that may be necessary. When faced with a new or a unique situation, decision makers have an obligation to identify the information they will need to make a decision about how to achieve the planning objectives and recommend a plan for implementation. Sometimes, the PDT has to anticipate those needs.

PDT Scoping Role

Scoping establishes the decision context of your study. That means identifying problems and opportunities, then specifying planning objectives and constraints, which express the PDT vision of what a successful resolution of the problem and opportunities will look like. Next, the PDT should identify the criteria it expects to use to make decisions throughout the planning process. This helps guide the evidence gathering process. The PDT also needs to describe what the future will look like if no action is taken as a result of the USACE study. Any unique questions that arise in this study that need answering need to be identified so they can receive the attention they need in the study. Finally, the PDT should identify all the key uncertainties they encounter in this first step. The PDT will need to reduce them as they plan forward.

Risk-informed planning is about reducing uncertainty to the point where the team feels comfortable making a decision. There is never

enough time or money to gather all the data you would like to have. There are always going to be things you do not know. Uncertainty is ubiquitous in planning. It is essential that the entire vertical team understand the information that you have and the information you will need to get at the outset of a study. This is done by identifying likely decision criteria, posing unique questions to be answered, and identifying the key uncertainties the PDT faces. Risk-informed planning purposefully and intentionally reduces the most critical uncertainty in a planning investigation. That begins here in the scoping work. The RR is the tool for encoding these risks.

The Great Lakes Mississippi River Interbasin Study presented the USACE with the need to develop expertise in conducting qualitative risk assessment for aquatic nuisance species. This entailed identifying unique questions that needed to be answered. There was no pre-existing template for assessing ANS risks.

The outputs of this first planning task are simple and essential. They are:

1. A written problems and opportunities statement
2. A without condition scenario
3. A list of planning objectives and constraints
4. A list of decision criteria that will lead to the choice of a course of action
5. A list of unique questions to be answered in the investigation
6. A list of the most significant uncertainties

Scoping is also considered a specific part of the National Environmental Policy Act (NEPA) process. That process also includes sharing pertinent information with affected federal, state, and local agencies; Tribal governments; and other interested groups or persons in an open forum usually called a scoping meeting. NEPA scoping is a different kind of scoping and is described in the textbox.

NEPA Scoping

The National Environmental Policy Act is the national charter for the protection and restoration of the environment. NEPA includes a requirement to prepare a detailed statement, either an Environmental Assessment (EA) and a Finding of No Significant Impact (FONSI) or an Environmental Impact Statement (EIS) of major federal actions significantly affecting the quality of the human environment and a Record of Decision (ROD). The Council on Environmental Quality regulations direct federal agencies, which have made a decision to prepare an EIS, to engage in a public scoping process. This process determines the scope of the EIS and is intended to ensure that problems are identified early and properly studied. It assures that issues of little significance do not consume time and effort. The scoping process should identify the environmental issues and alternatives to be examined in the EIS while eliminating nonsignificant issues.

Derived from GUIDANCE REGARDING NEPA REGULATIONS 40 Code of Federal Regulations (CFR) Part 1500

http://ceq.hss.doe.gov/nepa/regs/1983/1983guid.htm

6.3 Problems and Opportunities, also known as Risk Identification

The first significant scoping activity is identifying problems and opportunities. The difference in risk-informed planning is that planners are asked to see problems and opportunities as risks. Risks

are either losses to be reduced or uncertain gains to be realized, i.e., they are problems to solve or opportunities to attain. The practical confluence of risk management and the planning process begins by establishing the risk context or, more commonly, identifying problems and opportunities.

Problem Finding

You find a problem or a problem finds you. Some problems kick the door down inconveniently, find you, and follow you everywhere you go. They cannot be ignored. Other problems are more subtle and do their best to avoid detection. Opportunities rarely force themselves on a community. It may take a trained eye to spot an opportunity.

Einstein is supposed to have said, "If I had one hour to save the world, I would spend 55 minutes defining the problem." This is the key to good planning as well as to saving the world. Carefully, identifying the risks, i.e., the problems and opportunities that a study area faces is the bedrock of a good plan. Planners face many problems and opportunities that can be pulled from the mess. Pulling the right ones out is the planner's art.

Risk-informed planning follows a five-step process for establishing the risk context or identifying problems and opportunities. The process comprises the following steps:

1. Identify the risk
2. Own the risk
3. Articulate the risk
4. Vet the risk
5. Verify the risk

Each step is developed in turn below. The output of these five steps is a Problems and Opportunities (P&O) Statement, a single piece of paper that identifies the problems and opportunities your planning investigation will address. Identifying the problems and opportunities as risks brings the planning process into closer alignment with the USACE risk management model. It also establishes planning as a risk management activity.

6.3.1 Identify the Risky Problem or Opportunity

Risk identification (see Chapter 2) begins with a trigger, i.e., an event, a directive, stakeholder input, or an accumulation of information that makes the PDT aware of the existence of a problem or an opportunity. Once the PDT becomes aware of the existence of a risky situation, the first step is to identify the hazard or thing that can cause harm. It may be a seismic fault, a flood, climate change, uncertainty about funding, or virtually any other

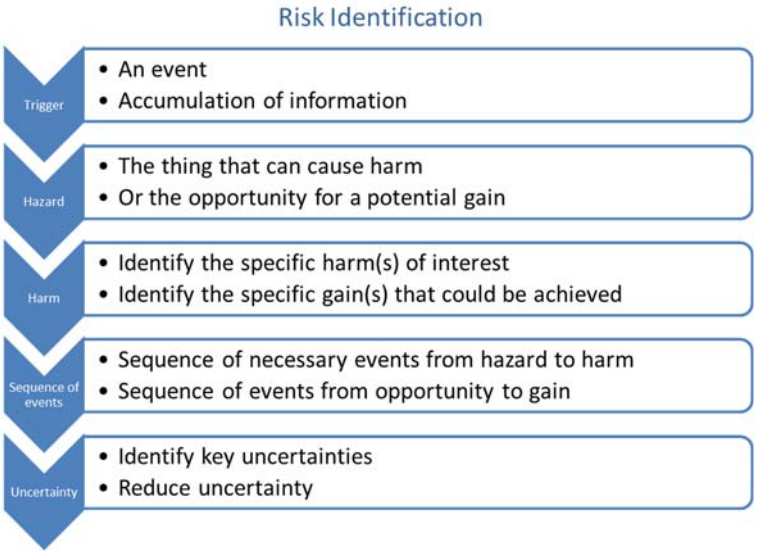

Figure 6.3: Identifying a risk from trigger to sequence of events

phenomenon of interest. Next, the PDT needs to identify the specific harm(s) the hazard can cause. Finally, the team needs to identify the sequence of events that is necessary for the identified hazard to cause the identified harm(s) in sufficient detail to establish the likelihood the harm(s) could occur. This may require multiple sequences or pathways for the same harm/consequence or multiple pathways for multiple consequences. Finally, the PDT should identify the key uncertainties and develop a strategy for reducing them. For opportunity risks the process is similar, but it begins by identifying the opportunity for gain that can result in some very specific potential gains. The team would then identify the sequence of events that is necessary for the given opportunity to result in those potential gains.

Triggers

Congressional authorization, locals request help, stakeholders tell you, flood, storm, infrastructure failure, evidence of failure mode, inspection reports, newspaper articles, biodiversity losses, and the like.

Planners should think comprehensively about risks and identify all of the decision-relevant risks. It is important to avoid the mistake of focusing too quickly and too narrowly on a single risk when there may be more than one. This means considering not only the existing risk but also residual, new, transformed, and transferred risks. Risk identification during scoping is a qualitative analysis that results in a narrative description of a risk. That narrative can later be reduced to a simple sentence or two to identify a problem or opportunity for the P&O Statement.

Risk identification is a critical first step in the uncertainty reducing process of separating what we know about a new study from what we do not know. A risk can be important because science tells us it is important. It can be important because some group has taken some significant, formal, or official action to stress its importance, or it can be important because people think it is important. Public input and feedback are needed for this work to become finalized.

Planning problems are usually ill-structured or wicked problems, situations where cause and effect, assumptions, structure, and objectives are unclear. Data may be sparse or missing. These kinds of problems must be explored and understood before they can be solved. Here are a few examples:

Should non-indigenous aquatic species be prevented from spreading to new waterways?

Should coastal areas take action to respond to potential sea level rise?

Should government-owned land be leased for private development?

How much of Springfield's open land should be preserved for potential use as detention

6.3.2 Own the Risk

When the PDT accepts a risk, they agree to address it in the study. Knowing a problem or opportunity exists is just the starting point for preparing a P&O Statement. The PDT has to decide which problems and opportunities it is going to address in their study. There may be copper in the sediment of a water control structure, and snails may be absorbing it. Eagles eat the snails and absorb the copper as well, but is that a problem you care about? You may hear that water quality is degrading, the mottled duck is disappearing, flooding is getting worse, and no one may yet know if any of this is actually true, much less why it is so.

Do not confuse this notion of accepting a risk with determining whether a risk is acceptable or not. They are two very different uses of the term. Accepting a risk during scoping does not render a risk acceptable!

Accepting the risk is a priority-setting step. Deciding what is included in the study and what is not is a significant scoping task.

Accepting a risk means the team will commit resources (personnel, money, and time) to understanding that risk.

This activity is complete when the PDT decides which problems and opportunities to address. Deciding what is and is not going to receive attention is an essential part of the scoping process.

6.3.3 Articulate the Risk

Once the PDT recognizes a problem or opportunity and decides to address it, it is time to write it down so the PDT and others can understand it. Stakeholder and public input is invaluable to this activity. This is when the risks previously identified are first articulated and reduced to words on the Problems and Opportunities Statement.

The first draft of this statement is likely to include substantial uncertainty. As uncertainty about the problems and opportunities is reduced, they will become better understood, and your P&O Statement will get better. Some items may be dropped from your list, or new ones may appear. It is more unusual if this does not happen, than if it does. Problems (1 through 6) and opportunities (7 and 8) can be articulated in simple sentences. For example:

1. Franklin Creek causes flood damage in the industrial sector of Central City.
2. Storm-induced erosion is degrading the existing shoreline ridge system that protects nationally significant coastal marshes along the entire coastline of Thomas County.
3. Hydrodynamic alterations of the river, including dams, are impediments to fish passage.
4. Larger ships currently experience transportation delays due to insufficient federal channel depths.
5. Restrictive channel widths limit ship passage to one-way traffic in many reaches.
6. U.S. Coast Guard records of groundings, collisions, and allisions identify four particularly troublesome areas of Harlequin Harbor.
7. Ecosystem services can be significantly enhanced and increased through restoration of historically extensive wetland.
8. Regional sediment management would have a direct positive effect on water quality and aquatic habitat.

This activity results in a completed P&O Statement. It should be considered a conditional statement that will change as you begin to vet it, verify the problems, and reduce uncertainty by gathering evidence. Planning is an iterative process, and you can expect to revise and refine the problems and opportunities statement several times before it is finalized.

6.3.4 Vet the Risk

Once the problems and opportunities are written down, it is time to try them out on others. What does the vertical team say about your P&O Statement? How does the public respond to it? Vet your problems and opportunities with your publics, partners, and stakeholders. Publish it appropriately. If you have limited opportunities to interact with stakeholders, then use technology creatively. Publish the P&O Statement on the study website, create a Facebook page, use social media to get your P&O Statement out in front of people. Show them your best thinking and ask: *Are these the*

problems and opportunities? What is missing? What is here that should not be? Does anyone have information about these problems and opportunities that would be helpful? Consider this effort part of the 55 minutes needed to understand the question.

The message to partners, stakeholders, and the public is we have listened to your concerns, and this is how we see the problems and the opportunities in this investigation, did we get it right? Others need to evaluate and affirm your articulation of the risks. Getting buy-in to the P&O Statement is critical to the ultimate success of a study. If this statement is not right, nothing else will be either.

Revise the P&O Statement as necessary. Always keep it up-to-date. As it changes, let people know how and why it changes. The vetting task is complete when you have sought, received, and considered feedback from partners, stakeholders, and the public and modified your problems statement accordingly.

6.3.5 Verify the Risk

The PDT's final task in establishing the risk context is to verify the problems and opportunities. This is done by objectively assessing the problems to assure they are as people say they are. This task could take some time to complete or it may be a no-brainer. The assessment may be qualitative or quantitative. The verification of the risk conditions begins the evidence gathering process in earnest. Verification through assessment is an important part of establishing the risk context. Until there is objective evidence that verifies the existence of a problem (or opportunity), the P&O Statement is basically a hypothesis. The evidence gathered while assessing the problems confirms or rejects the hypothesis. Eventually, once problems and opportunities have been verified, you may develop an expanded profile and description of each item.

What Should the Problem and Opportunity Statement Look Like?

It is written down. It is short, a page or two at most. Each problem and opportunity is succinctly stated in a sentence or two. They are numbered for convenience.

The P&O Statement makes clear what will and will not be considered during the course of the investigation. Ideally, if a stranger asked you, *Why are you doing this study?* you could hand him this statement, and he would understand after reading it. The planning document can still weave a story and explain the problems and opportunities in as much detail as necessary. The P&O Statement, however, needs to be clear, concise, and complete. It is essentially the investigation's mission statement. An example is shown in the textbox below. There are two things to do with a P&O Statement: (1) use it, and (2) make it better. How do you know you have a good P&O Statement? When people understand it, it is good. How do you know when it is final? When people agree with it and you no longer find a reason to change it, it is final. Do not wait until you have a final P&O Statement to begin using it. A good statement takes time to develop, but a useful statement is the one you currently have.

Sample Problems and Opportunities Statement

Problems

1. Larger ships currently experience transportation delays that increase costs due to insufficient federal channel depths.
2. Some ships encounter delays by waiting on slack or flood tides to avoid difficult ebb tide crosscurrents at the confluence of the Club and Eeling rivers, which makes turns immediately north of the Edith Grove Bridge hazardous.
3. Some ships must reduce their speed to avoid bank suction effects in the Cavern Creek reaches, which results in transportation delays that increase costs.
4. Restrictive channel widths limit ship passage to one-way traffic in many reaches, resulting in traffic delays that increase costs.

Opportunities

5. Channel improvements can bring the forecast volume of goods into the harbor on fewer ships, resulting in transportation cost savings.
6. There is an opportunity to improve the harbor ecosystem through beneficial use of dredged material.
7. Improving dissolved oxygen levels in the harbor could benefit aquatic species.
8. Sediment management could restore sediment supplies on Jones Beach.

6.4 Without Condition Scenario

With a preliminary P&O Statement in hand, it is time to begin to address the uncertainty in the study. A helpful way to begin, and part of the work of verifying the problems and opportunities, is to identify the future of the study area with no new or additional federal actions. Will the problems get worse or will they go away? Will new problems emerge? Will any of the opportunities for gain be realized? The PDT's vision of the most likely future, absent federal action, is called the without condition scenario, and it is the single most important scenario the PDT will be tasked with identifying. It is primarily a qualitative effort in the scoping process that quite likely results in an uncertain narrative description of the future.

If the without condition scenario describes a desirable future state of the study area, no further action by the study team is necessary. If the without condition is less than desirable, then this scenario becomes vitally important to the formulation, evaluation, and comparison of alternative plans.

Scenario analysis is really a two-part task. First, the PDT develops the narrative that describes the most likely version of the future. Next, the PDT *inhabits* this scenario narrative by assuming the conditions of that scenario to be factual and then does all of its without condition analysis of problems, opportunities, decision criteria, resource conditions, and the like in accordance with the assumptions of that future scenario. If there are alternative without narratives, the analysis is repeated for each scenario narrative.

For a simple example, imagine an effort to restore ecosystem values along a small urban stream. The without condition scenario assumes a future with continuing degradation of water quality, increased trash dumping in the floodplain, and rising criminal activity in the wooded areas of the stream. That narrative is the without condition. Next, analysts use that basic storyline to do realistic

analysis of variables and relationships critical to the problems and potential opportunities that exist in that watershed. Imagine that evidence is gathered and models are run that estimate species abundance in the watershed may have a 50 percent or greater chance of decreasing by more than 20 percent. Water quality studies forecast quality degradation beyond the point where the stream can support aquatic life. Hydrologic and hydraulic analysis shows the dumping exacerbates flood problems. These and other effects are not determined by identifying the without condition scenario; they are the products of the analyses the PDT performs within the without condition scenario. Scenarios and the uncertainty that attends them is covered in more detail in the Chapter 7.

For now, think of a scenario as a synopsis or description of some condition or situation of interest, specifically, future conditions in the study area without any federal action as a result of a study.

The PDT will develop a future scenario, called a with condition (or with project condition), for each plan they formulate. Analysis of select decision criteria is done under the without and with condition scenarios. Then, the with condition values of decision criteria will be compared to the without condition values of the same criteria in order to estimate the effect of a plan on the decision criteria.

Scenarios are sometimes factual, sometimes speculative, and often a mix of the two. Aspects of the future that can be inventoried and described with certainty contribute to the factual dimensions of a scenario. Uncertain aspects of the future always abound. The without condition scenario is usually a mix of fact and speculation about the future. It is a story about what might be; in fact, think of it as a history of the future. As details are added to the without condition, over time, this scenario will become better understood with the analysis. Thus, expect the without condition to change and evolve, along with everything else about the study. The without project condition becomes the baseline picture of the future. To learn how alternative plans will alter the future, you are always comparing alternative future condition scenarios to this same without condition scenario.

6.5 Objectives and Constraints

With problems and opportunities identified and a rough idea of what the without condition looks like, it is time to define what a successful plan looks like. *Objectives* identify planning outcomes that define a successful resolution of the problems and attainment of the opportunities identified. Sometimes, success can be achieved by not doing things. When there are things that should not be done to realize the desired outcomes, they can be expressed as *constraints*. Grab that P&O Statement you just completed. Take each problem one at a time. What would a successful resolution of that problem look like? Write it down. Repeat this process for every problem. Now take your opportunities one at a time. What does realizing them look like? Write it down. Repeat this process for every opportunity. Now examine the without project condition. Does it result in any undesirable situations that have not yet been covered? What would a successful resolution to such a situation look like? You are articulating for the PDT and others what a successful plan will accomplish. Objectives and constraints define success for the planning process. They tell everyone what a successful plan would do.

Got a flood problem? What would a successful resolution of it look like?

- Reduced flood damages.
- Reduced risk to life, health, and safety during floods.
- A revived and sustainable central business district.

These are your objectives.

Planning objectives identify the things that you want to see happen. Constraints identify the things you do not want to happen. A successful plan achieves its objectives and avoids its constraints. Objectives are based on the problems and opportunities. Constraints may also be, but they usually are not.

The objectives state in broad and general terms what planners intend to do about the problems and opportunities they face. Done well, objectives reflect the most important values in the decision process. If flooding is one of the problems, protecting lives and reducing property damages might be objectives. An objective does not say how those things can or should be done, only that it is an objective to do so. It is a clear statement of a desired end that subsequently formulated plans are intended to accomplish. Objectives reflect the most important social values in the decision-making process. They identify the things planners are trying to do.

Objective and Constraint Verbs

eliminate, reduce, minimize/maximize, enhance, harmonize, identify, define, describe, increase/decrease, raise/lower, strengthen/weaken, avoid, adapt, blend, reconcile, coordinate, affirm, diminish, weaken, promote, encourage, raise, complement, strengthen, ensure, control, do not

Constraints are important to consider. There are some rather universal constraints that include not violating national laws like the Clean Water, Clean Air, and Endangered Species acts as well as any state and local laws and regulations. Study-specific planning constraints are unique to a specific planning study that alternative plans should avoid doing. Examples include:

- Do not induce saltwater intrusion to freshwater aquifers
- No loss of flood protection from an existing levee system
- No increase in shoreline erosion related to navigation
- Avoid regional loss of jobs or income
- Do not adversely impact the southern sea otter

A good objective or constraint is not:

An absolute target, they do not specify a particular level of achievement.

A specific measure, they do not prescribe a specific course of action.

A political or governmental goal.

A planning task.

A resource constraint like time, money, or expertise.

The output of this process is a short, 1 to 2 page, written Objectives and Constraints (O&C) Statement. At a minimum, each problem and opportunity is reflected in an objective or a constraint that is succinctly stated in a sentence or two. They are numbered for convenience.

A good objective/constraint is:

- Specific, i.e., it is clear and free from ambiguity.
- Flexible, it can be adapted to new or changing requirements.
- Measurable by some objective means.
- Attainable, plans can reach the objective.
- Acceptable, they are welcome or pleasing to key stakeholders.

A good O&C Statement reflects the values of the affected communities. They identify what is important to people. Be sure to involve stakeholders and the public in this process, especially those whose cooperation is needed to implement the plan and make it successful. Publish and vet this list along with the P&O Statement; it is a critical scoping output. Like

the P&O Statement, the O&C Statement is conditional and subject to change as you iterate your way through the planning process. Because this document reflects key social values, it is a good guide to your decision criteria.

Sample Objectives and Constraints Statement

Objectives

1. Reduce existing transportation delays in Dry Fork Harbor.
2. Reduce the risk of marine casualties during turns north of Edith Grove Bridge.
3. Enable Dry Fork Harbor to exploit economies of scale from a larger calling fleet.
4. Improve the harbor ecosystem.
5. Increase aquatic species in the harbor.
6. Improve recreational experiences at Jones Beach.

Constraints

1. Avoid loss of competitive advantage among regional port network.
2. Do not violate state water quality statutes near Jones Beach.
3. Avoid adverse impacts to coral adjacent to the project area.
4. Avoid violating maritime safety requirements.
5. Avoid or minimize impacts to any shallow water aquifers.
6. Avoid or minimize impacts to cultural resources.

6.6 Decision Criteria

Eventually, the PDT is going to have to decide which of the plans it has formulated that has the best chance of making the success story embodied in the O&C Statement a reality. To do this, measure each plan's contributions toward that success and required decision criteria. These criteria will help judge what is good and what is bad; what is beneficial and what is adverse; and what is desirable and what is undesirable about the individual plans for the evaluation, comparison, and selection decisions that must be made. To ensure that the PDT has the information it needs when it needs it, the PDT must identify these decision criteria as early in the process as possible; ideally, during scoping. Fortunately, some of these criteria are easy to identify. Knowing the benefits, costs, and environmental impacts of each plan will be important as well as their contribution to your objectives and constraints. Scoping is the time for the PDT to think about the specific metrics that will be used to capture those values.

Information appears neither by accident nor cheaply. If the PDT knows what information will be needed to make decisions from the start of the study, there is a much greater chance that information will be available when and in the form it is needed. There is also a better chance that scarce study resources will not be used to gather information that does not support decision-making. The desired output of this scoping task is a written list of the decision criteria most likely to be needed to identify a TSP.

Decision criteria are needed for the following key decision categories:

- Scoping
- Measures screening
- Evaluation
- Comparison
- Selection

Criteria are the attributes, variables, and values associated with a decision problem that are important to decision makers. A criterion is something the decision makers care about and something that can influence the decision makers' choice. You should expect the decision criteria for a study to reflect the planning objectives and constraints. Criteria may vary from decision-to-decision.

The scoping process described here sets the study's boundaries. Scoping criteria are used to determine what will and will not be considered in the study. They may include considerations like policy, authorities, geography, politics, and other such broad concerns. Screening criteria are used to select some planning measures from many candidate measures. Scoping and screening criteria should be identified and documented as they are used. In practice, they are not documented as often as they should be.

Evaluation, comparison, and selection criteria are used in the third planning task, *Deciding*. These criteria may be identical, they may overlap to varying extents, or they may differ entirely from one decision to the next. What they all have in common is that they should be identified during the scoping task to the maximum extent possible.

The USACE Civil Works Program has been authorized by Congress and the President to provide the following for the nation through water resource projects.

- Coastal protection
- Disaster preparedness and response
- Environmental protection and restoration
- Flood risk management
- Hydropower
- Navigable waters
- Recreational opportunities
- Regulatory oversight
- Water supply

A Good Criterion Is

Appropriate to the decision being made
Supportive of decision making
Explicit
Measurable
Based on evidence
Quantitative
Specific
Discriminating
Reliable
Honest about uncertainty
Reproducible
Verifiable
Clear about thresholds
Documented

The specific decision criteria for these projects' purposes may vary. From 1983 until the time of this writing, the *Principles and Guidelines for Water and Related Land Resources Planning* have dictated that net national economic development benefits will be the primary decision criterion for selecting a

solution. That will be one of the decision criteria for the near future. Planning partners with a say in the final decision-making process may identify criteria they absolutely require to make a decision. These are also candidate decision criteria.

A study can generate information on dozens or even hundreds of variables and effects during its course. Those that are included in the study are included because someone cares about these effects. Some effects are identified as criteria out of habit. They were criteria in a previous study, so they must be criteria in this study. Others may be items from checklists such as those used for the NEPA process. Still others function simply as filler, chosen for reasons no one can quite articulate. These may all be important components of a study, but they are not decision criteria unless they are used to make a decision. Criteria are those things that actually influence the decision-making process. Focus on those criteria that will be used in evaluation, comparison, and selection decisions. These things are important to decision makers. What you most want to avoid is a process that relies on producing a potpourri of plan effects from which decision makers cherry pick a few upon which to base a decision. That process wastes study resources. Know what is important to decision-making and then provide it.

Plan Effects ≠ Decision Criteria

Plan effects are not the same as criteria. There are many things people care about and will want to see that will not play an explicit role in decision-making. It is common practice in some studies to prepare a "list of plan effects" that summarizes the many and varied effects of the plan. This can be valuable and useful information, but most of these effects or impacts are not decision criteria.

A plan effect is something that happens because of a plan. It is a measurable impact. A criterion is a plan effect or factor extrinsic to the plan that is explicitly considered in one or more decision-making process during a planning investigation.

If you think of plan effects as must have, should have, could have effects, decision criteria are the must have effects.

Practically speaking, uncertainty may be too great to identify all the specific criteria needed this early in the planning process. In any event, the PDT, with input from partners and appropriate stakeholders, ought to identify as many decision criteria as possible in the scoping process. This task is complete once the list of tentative decision criteria has been created.

6.7 Other Information Needs

Decision criteria are not the only important information in a planning study. For example, there may be important, *should have*, plan effects. A study may require substantive areas of new domain expertise. Unique environmental conditions may require knowledge of rare species or a new issue, e.g., aquatic nuisance species, or new navigation technology may require new subject matter expertise. When new or unique information likely is needed for a study, it is important to say so as early in the study as possible.

The goal of this activity is to continue to reduce uncertainty. Ideally, the PDT would pause while scoping the study and ask, *What other information are we or our vertical team going to need to make the decisions*

Aquatic nuisance species are unique and require new questions to answer. Can Asian carp reach Lake Michigan? Is there a hydrologic pathway?

Can they survive in Lake Michigan?

Can they establish a breeding colony in the lake?

Can they spread from there to other waterways?

How effective are electronic barriers?

Decision makers will often need help formulating these kinds of questions. Analysts may be in the best position to anticipate what is likely to be most useful to decision makers.

necessary to identify the TSP? Now is the time to pose the questions which will provide the information needed to identify the TSP.

There may already be a well-developed template for conducting studies for recurring problems with well-known decision criteria. Given a flood risk management planning study, every experienced person on the PDT swings right into action because he or she knows what is required to successfully conclude the investigation. Many planning investigations will include a unique circumstance that requires some new information. One-of-a-kind planning efforts arise often enough that they are not unusual. In these cases, everything about the investigation is ad hoc, and the decision makers' information needs must be specified.

What kinds of questions might be helpful? The kinds that yield information that can be used for decision-making. In general, think of the questions as coming from four broad categories:

- Problem/opportunity characterization
- Objectives and constraints
- Plan performance
- Public involvement

Problem/opportunity characterization questions ask for information at an *effects of the problems/opportunities* level, not at a details level. How long can the mottled duck survive if we take no action? How many people could die if the levee fails? How many habitat units will be lost in the next decade if we do nothing? What information do we need to verify that our problems are really problems?

Ask questions that focus on objectives and constraints. What kinds of information is needed to formulate options that achieve goals and avoid constraints? What kinds of information are required to assure objectives are attained and constraints avoided?

Plan performance questions may be important. What options do we have? Is there anything special we should be considering? What are their intended effects? What are their unintended effects? How well will the options work together? What do you need to know to formulate and choose the best option? How are outcomes of the plan measured?

Public involvement questions focus on the perceptions of partners, publics, and stakeholders. What are the third rail issues for the public? What do your planning partners care about? Who cares about the study and how much?

This activity may overlap the identification of decision criteria. Its purpose is to identify unique information needs that will not be reflected in the decision criteria. The output of this task is another single sheet of paper. On it are written the questions that need to be answered in order to choose a TSP.

6.8 Uncertainty

What the PDT is figuratively doing in the scoping process is making a pile of the things they know and a pile of the things they do not know about their study. This last scoping activity requires the team to look carefully into the pile of things you do not know in order to identify the most important uncertainties that remain. A major strategy in risk-informed planning is to reduce uncertainty strategically to enable the PDT to identify the best TSP in the shortest time and for the least resources practical.

Knowledge uncertainty is the uncertainty attributed to a lack of knowledge on the part of the observer. It is reducible in principle although it may be costly to reduce or it may require significant time in advance of a decision to do so. Knowledge uncertainty arises from incomplete understanding of a system, modeling limitations, and/or limited data. Natural variability is the uncertainty that deals with the inherent variability in the physical world. This *randomness* is assumed irreducible in principle. Variability can occur over time, space, or among the elements of a population. For example, stream flow at a given location varies over time while soil properties vary over space.

Planning investigations need to be intentional about both of these sources of uncertainty. Much of the uncertainty at the outset of a planning investigation will be reduced or even eliminated as evidence is gathered and analyses are conducted. Thus, some amount of the initial uncertainty is simple ignorance of the facts that will be reduced as evidence is gathered and analyzed. However, some of the uncertainty will persist. Anticipated sources of significant and persistent uncertainty should be identified as soon as possible so they can be addressed intentionally throughout the course of the study.

The outcome of this task is one more single sheet of paper that identifies the major sources of uncertainty that exist as understood at the start of the study. The project management plan (PMP) will naturally target much of that uncertainty, so it is especially helpful to identify sources of uncertainty that are expected to persist throughout the study process.

6.9 Six Pieces of Paper

A good scoping process produces six very useful pieces of paper early in the study; they are:

1. A P&O Statement that explains why this study is being done.
2. A narrative description of the without condition scenario.
3. A list of the planning objectives and constraints that state in broad terms what a successful plan will do.
4. A list of decision criteria that identify what the PDT knows or believes to be important to decision-making.
5. A list of unique questions decision makers would like to have answered as the investigation proceeds.

6. A list that singles out for attention those uncertainties that are likely to be most significant in the study.

Keep these papers up-to-date. Date them; they will change. Publish this information, as appropriate, and circulate it as widely as interest allows. Armed with these six pieces of paper, the PDT is ready to begin the creative work of planning; the first iteration of the scoping task is complete.

6.10 Five Points to Take Away

Here are five key points to take away from this chapter.

1. If a study is not scoped correctly, then, little that follows will matter. Understand the problems you are trying to solve and the opportunities you are trying to realize.
2. Prepare an honest without condition scenario narrative.
3. Define what success looks like by saying what a successful plan will and will not do in your objectives and constraints.
4. Carefully separate what you know from what you do not know and be honest about what you do not know.
5. It is not real until it is written down; get those six pieces of paper in your hands.

6.11 Addendum One: Problem Identification Techniques

Some problems kick down your door and sit on your desk. Others are routine and familiar and they require little effort to identify. There is little uncertainty about what these problems are or how to solve them. Some problems are more difficult to identify. There is often a lack of information and much uncertainty about what the problem really is in these situations. Symptoms of problems are often confused with the causes of problems. The most difficult problems are complex, ambiguous, and accompanied by a lot of uncertainty. These require more effort to identify.

Several techniques for identifying problems are introduced in this addendum. Although the focus is on problem identification, the techniques are equally adaptable for identifying opportunities. Successful planning requires the vertical team, their partners, stakeholders, and the public to have a common view of the problem(s) to be solved. When a diverse group of people, however large or small, is expected to come to a common understanding of anything, process is important. Many competent adults have little use for a formal process. We are all professionals; certainly, we can identify a problem, right? Maybe not, at least not easily. A formal process can help a PDT work more effectively and efficiently.

The techniques presented in this addendum can help you understand complicated and difficult situations. A structured and methodical approach to organizing and framing problems can be invaluable to a successful problem identification process.

There are dozens of problem identification techniques in use, and more are invented all the time. This addendum presents techniques found useful over the years. These techniques supplement and support the risk identification process described earlier.

6.11.1 Ishikawa Diagram

Cannot figure the problem out? Draw it. Cause and effect, fishbone or Ishikawa diagrams are effective drawing tools for detailing the cause and effect nature of your problem(s). An Ishikawa diagram is shown in three parts in Figure 6.4. Begin the diagram by identifying the recognized problem in the problem box shown at the top of Figure 6.5. The straight line indicates the *cause* of this problem's *effect*. Next, identify all the relevant factors that contribute to this effect; brainstorming can be effective here. These factors are depicted in the middle panel.

Mindtools (2008-2010) suggests using 5 Ms and an E to identify these Ishikawa factors: man, method, machine, material, measurement, and environment.

Man = people-related factors

Method = process, procedure, instructional, and similar causes

Machine = technology, capital, equipment, and the like

Material = resource inputs, their quality, quantity, and other relevant attributes

Measurement = quality of data and instruments used to record it

Environment = external environment,

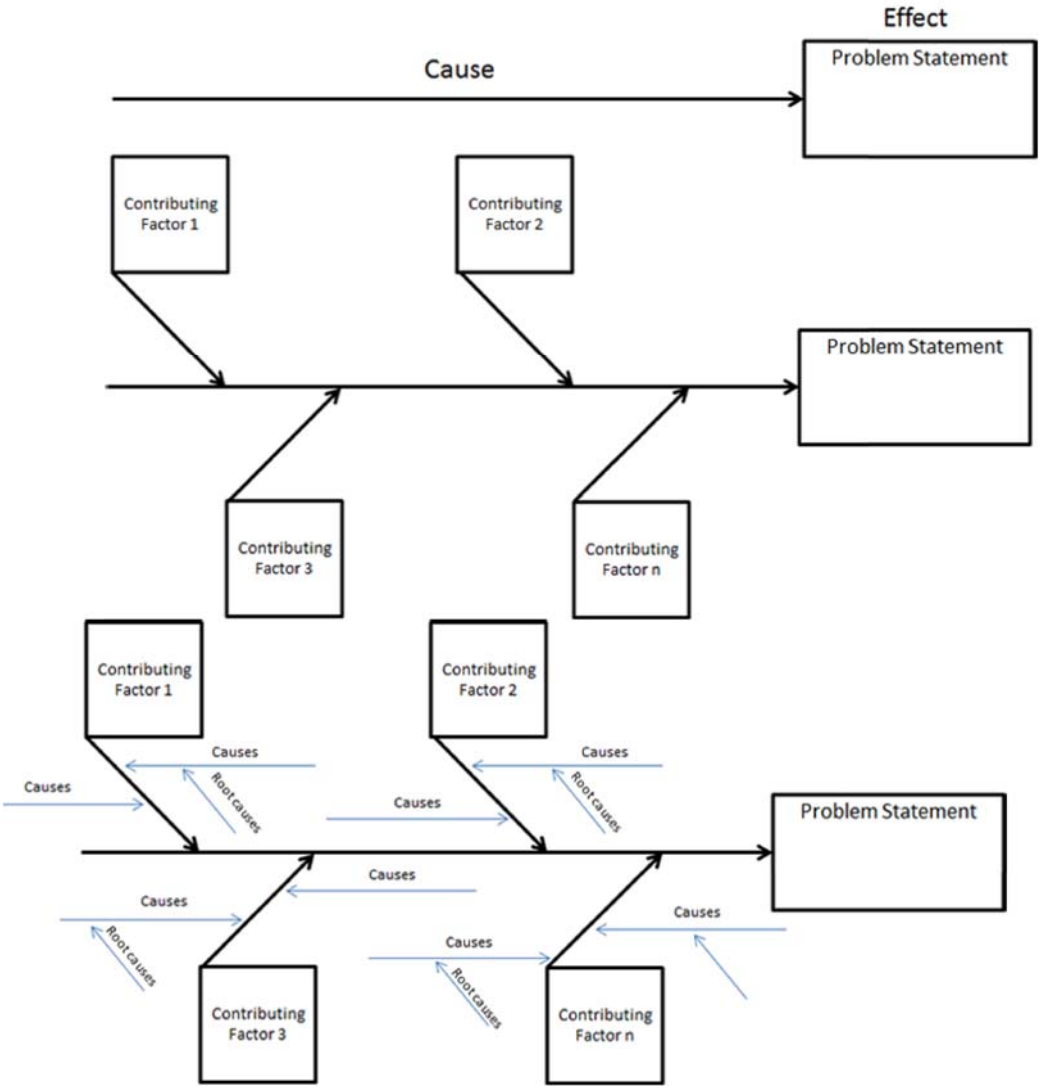

Figure 6.4: Evolution of an Ishikawa (cause and effect) diagram

The bottom panel of the figure shows how specific causes under each factor cluster would be included in the diagram. There would be as many of these causes along with their root causes as the team can identify.

The best way to produce this diagram is the why-why approach. This is a sequence of why questions. There is a flood problem. Why? Because of rainfall? Why is rainfall a factor? Because of increased runoff? Why is that a factor? Because of climate change. This kind of logical decomposition of the problem is illustrated in Figure 6.5. Three to five levels of why will be enough to get to a root cause. The diagram captures that logic.

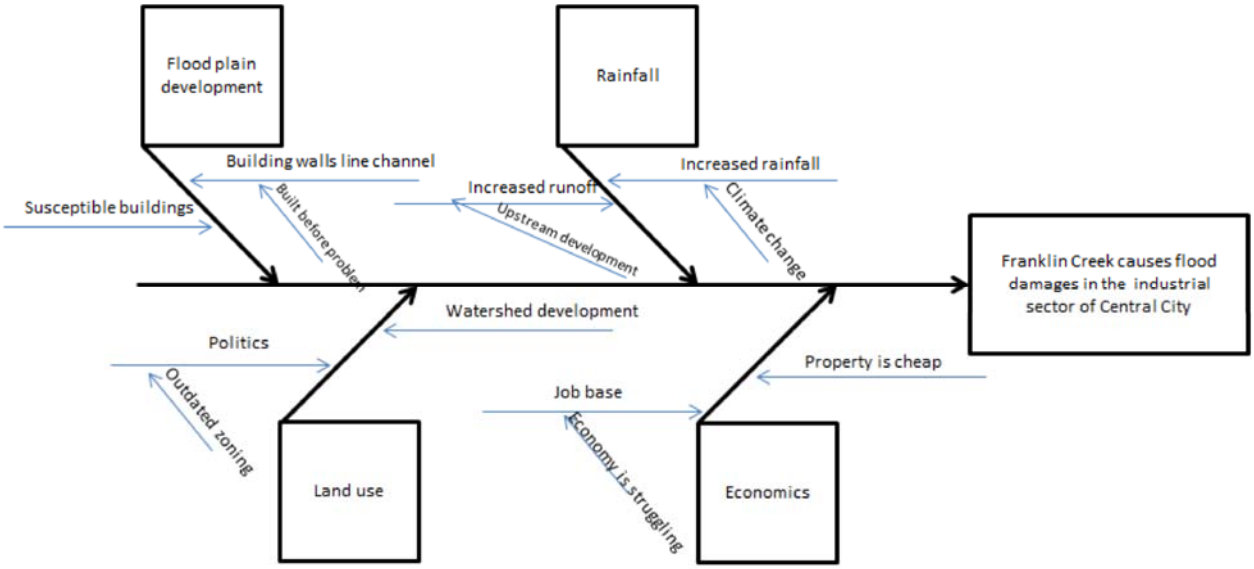

Figure 6.5: Simple Ishikawa diagram for a flood risk management problem

A completed diagram provides a more complete view of the problem and enables planners to write a more objective problem statement. The diagram's details support a rich narrative description of the problem if desired. It provides an effective starting point for identifying measures that may eventually help solve the problem. Root causes of problems are a good level at which to begin to consider solutions. When a particular cause is found under several factor categories, there is a good chance this is a root cause.

6.11.2 Brainwriting

Brainwriting can be an effective technique for getting a group started with problem identification. All it requires is a group of people, some index cards, and pens. It involves everyone, and it is not easily dominated by a strong personality. More importantly, it produces useful results.

Split the assembled team members into groups of four or five. Give everyone an index card and pencil. Ask them to write down the most important problem in no more than two sentences, beginning with the phrase: *The problem is...* When everyone is done, pass these initial problem statements to the left so that each person is looking at another person's problem statement. Ask each person to improve on the problem statement before them. Do not change the statement to make it sound like your own statement; wordsmith and improve the statement received. Make it better. When the revisions are done, pass the cards to the left once more. The process continues

until the writer receives his/her original statement. Then, looking at the edits to the original statement, each person prepares a revised problem statement.

At this point, the small group chooses, by any means possible, one statement from their group as the most important problem. If this involves discussion and negotiation over the final wording, that is okay. Each group reports its best statement, followed by a plenary discussion and refinement of the initial list of problems. By the end of this process, expect to have the top one to three problems articulated in an initial form. The entire process takes less than an hour.

If there are multiple problems, a variation on this process may be used. This six-step technique works best with groups of four to up to twenty people.

1. Each individual silently writes down his/her ideas about the problems on a sheet of paper.
2. The papers are placed in the center of the table (or some other pool).
3. Each individual takes a sheet of paper from the pool, reads the ideas on the new sheet, and uses them to stimulate new ideas, which are added to the sheet.
4. Once any new ideas are added to the sheet, it is exchanged for a new sheet from the pool. Often there may be a rule that at least one new idea must be added to a sheet before it can be returned to the pool.
5. Each individual continues to write down ideas and exchange sheets for three or more iterations.
6. At the end of the process, the ideas are read aloud for clarification and wordsmithing. The problems so identified represent the initial articulation of problems.

6.11.3 Brainstorming 3X yeah

The Internet is full of brainstorming techniques. Ken Orth, a USACE planner, developed a process called *3X Yeah*, (as in the Beatles' "Yeah, yeah, yeah"). It works like this:

- Provide materials
- Identify the question to be brainstormed
- Explain the process
- Silent idea generation (brainwriting)
- Group idea generation (brainstorming)
- Preliminary evaluation
- Award prizes
- Follow up

A workspace is needed, with enough room to break out into small groups of six or less. Index cards and pencils are needed for private idea generation, and a flip chart with markers (or some other communal form of recording, like a laptop and projector) is needed for each group.

The question can be as simple as, *What are the problems we face in the Dry Fork Harbor planning study?* The process is easy to explain. It has the following simple rules:

- No evaluation
- No judgment
- Quantity counts
- Time is limited
- Follow the process
- Generation of ideas is separate from judgment of ideas

Participants are informed that the goal is to generate as many ideas about problems as possible in the time allotted. To do that, they should not evaluate or judge any ideas, just compile as many as possible. Write down anything that comes to mind during the process. Capture ideas. Do not worry if an idea is good or bad, complete or not. Ideas can be evaluated later.

The process begins with silent idea generation. This assures everyone participates, and it minimizes the likelihood that strong personalities will dominate the process. Make sure everyone has several index cards, or a piece of paper, and something with which to write. Write legibly because all cards will be collected. The facilitator begins the process by giving the group three minutes to list 10 problems the study faces. If there are more than 10 problems, keep going; shoot for at least 10. Everyone is to work silently for the three minutes.

Forming Groups

Instead of counting off by 3s or 5s to form small groups, try this instead. Ask someone for their favorite letter of the alphabet, TV show, city to visit, color, beer, or any random thing you can imagine. Write the response down for all to see. Then ask your next goofy question of another person. When you have as many answers as groups you want to form, have them count off by the answers, e.g., A, Leave it to Beaver, Berlin, Green. These become your group names, and the exercise usually throws enough people that it can provide a few laughs along the way.

Warning. Never attempt humor if you are humor impaired.

After three minutes have passed, ask if anyone had more than 10 ideas. Then ask if anyone had 10, 9, and so on until most of the group has raised their hands. If you would like to inject a little fun into the process, toss the person with the most ideas a token prize of candy or some other trinket that would be regarded as fun without crossing over into competitiveness or jealousy.

Congratulate everyone on their efforts and results, and do not feel guilty if you lead them to believe they are done. Then tell everyone to draw a line beneath the last idea. Explain that the first time through everyone was getting the obvious stuff, the low hanging fruit. Give them three more minutes and ask for 10 new ideas. When the time is up, repeat the query of your group, asking if anyone got more than 10 ideas. Before moving on, ask if anyone failed to get any new ideas. It will be rare that someone

did not; be gentle with anyone who comes up blank. Take the process seriously, but have fun with it.

If some people were still generating three or four or more new ideas, it may be worth one more round of silent idea generation. This time give them one minute and ask for three ideas. Never ask people to generate their own ideas more than three times.

Use a random process of some sort (see textbox) to form small groups for some oral brainstorming. Counting off is a simple way to break the chosen seating patterns and to form groups. An ideal group will be five or six people. The group's charge is to use their personal lists of ideas and as a group make the longest list of unique (non-repeating) ideas they can. Have the groups number and record their list on flipchart paper, a computer, or some other medium that others will be able to see.

Start the brainstorming process by asking everyone for one idea from their list. Going around the group until no new ideas are coming out is polite but not much fun. An alternative is to encourage people to blurt out any new ideas they get from the ideas of others. The sole goal is to keep the ideas coming, without any judgment or evaluation of anyone else's ideas. Offer the group with the most ideas a prize—ice cream on a stick, candy bar, an hour off with pay—to spur some friendly competition among the groups. Thirty minutes is usually sufficient for this task. If more time is needed, take it.

When the group idea generation is complete, the team moves into evaluation phase. Ask each group to select their best idea, their worst idea, and their wildest idea. To get people to read the ideas of others, have the groups exchange lists and vote these 'honors' to another group's list. Each group reports its selections. Collect the index cards and flip chart paper, and call it a productive hour.

Now, the critical question is, what is to be done with all this information? Without productive follow-up, an hour of everyone's time has been wasted. What has been done, however, is the generation of many ideas from many people in less than an hour.

Compile the problem ideas and feed them back to all participants as swiftly as possible. It is time for convergent thinking. You want to go from many ideas, weeding out the weaker ideas, to get the best ideas. This requires more group evaluation. Dot voting, discussed below in Section 6.11.7, is one option that works well.

Pitfalls to Avoid in Problem Definition

1. No focus--definition too vague or broad.

Example: Lack of biodiversity in the watershed.

2. Focus is misdirected - definition is too narrow.

Example: How can we improve conditions for the mottled duck?

3. Statement is assumption-driven.

Example: How can we stop harmful human disturbances?

4. Statement is solution driven.

Example: Mallow Marsh needs a water control structure.

6.11.4 Be a Reporter

When it comes time to identify problems, you can do a lot worse than to ask some who, what, when, why, where, and how questions. Who is causing the problem, or suffering from the problem? What is causing the problem? What are the consequences of the problem? When does the problem occur? Why does it occur in this way? How did we become aware of the problem? Where does the problem occur? Where are the consequences visible?

6.11.5 Mind Maps

Mind maps are growing in popularity and ease of use. These are diagrams used to represent ideas and their linkage to a central concept. They are extremely useful for visualizing, structuring, and classifying ideas. Mind maps are useful for analyzing, comprehending, synthesizing, recalling, and generating new ideas as well as for illustrating problems. Figure 6.6 shows a simple example of a mind map linking various ideas about Asian Carp reaching the Great Lakes from the Mississippi River. A map like this makes it easier to see the complexity of the problem and develop a well-focused problem statement.

Figure 6.6: Simple mind map diagram for an Asian carp entering Lake Michigan

6.11.6 Restatement

Restatement is a good technique for a study's highest priority problems and opportunities. After the first iteration of the P&O Statement, restatement can be used to make sure everyone understands how different a problem can look to others. The idea is simple; restate a problem in as many ways as you can. Imagine it from the different perspectives of partners, stakeholders, and the public; then different professions and different individuals like Homer Simpson, Superman, or the mayor. How would EPA, the State Department of Natural Resources, recreationists, neighbors, scientists, uneducated people, politicians, and so on state the problem? Imagine how different magazines (e.g., Mad, Popular Mechanics, Home and Garden) would describe the problem. The goal is to identify as many different ways of seeing and expressing the problem as possible. Write them down. Do you see the problem any differently? Do you understand it better? If so, it may be time to re-articulate your P&O Statement.

Other Restatement Techniques

Instead of focusing on different groups or individuals, there are other ways to restate a problem, using different words or perspectives. Here are a few examples that have proven effective. Restating should take no more than 5 or 10 quality minutes if you start with a basic statement of a problem.

Initial Statement: Freshwater fish and invertebrate species are being eliminated.

1. Paraphrase: Restate the problem using different words without losing the original meaning.
Paraphrase: How can we preserve and restore freshwater fish and invertebrates?

2. One hundred eighty degrees: Turn the problem on its head.
180 degrees: How can we eliminate freshwater fish and invertebrate species?

3. Broaden the focus: Restate the problem in a larger context.
Broaden focus: How can we achieve greater biodiversity?

4. Redirect the focus: Boldly, consciously change the focus.
Redirected focus: Saltwater fish species are on the increase.

5. Use the why-why approach: Ask "why" of the initial problem statement. Then formulate a new problem statement based on the answer. Then ask "why" again and again restate the problem based on the answer. Repeat this process a number of times until the essence of the "real" problem emerges.
Freshwater fish and invertebrate species are being eliminated.

Why? Because salinity levels are changing in the marsh.
Restatement: Salinity levels are changing in the marsh.

Why? Because saltwater has entered this formerly freshwater marsh.
Restatement: Salinities in the freshwater marsh are increasing.

Why? Because the navigation channel has introduced a saltwater wedge to the river that abuts the marsh.
Restatement: Dredging has increased salinities in the marsh, eliminating freshwater fish and invertebrates.

6.11.7 Dot Voting

This is a great process for finding out quickly how a large group feels about an issue. Dot voting is a good way to find out how your team feels about a long list of brainstormed problems. It can also be used with stakeholders or the public.

It requires a room large enough for people to move about freely. Materials needed include, flipcharts or flipchart-sized paper that can be affixed to the walls with candidate problems written on them and a supply of colored sticky dots.

Imagine we have listed the problems identified from the 3X Yeah process described above. Give each person a supply of colored dots, five is a nice round number. Read off the problem statements for the audience. Ask those participating to circulate around the room and vote for the problems they consider most important. They can distribute their votes in any way they like. They can give one dot to each of five different problems or they can vote all five to a single problem.

An accumulation of dots around a relative few problem statements can reveal a growing consensus among the participants about what is important. Conversely, the lack of a consensus will be visually clear as well. For a variation, tag a point value to the different colors of the dots. Value one color of

dot three points, another color worth two, and a third color one point per dot. This enables people to vote with stronger preferences.

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Chapter 7
Ongoing Process—Gather Evidence

"The more that you read, the more things you will know. The more that you learn, the more places you'll go." — Dr. Seuss — Dr. Seuss, I Can Read with My Eyes Shut!

7.1 Introduction

You are likely to be gathering evidence and doing analysis from the first day of your study until the last. Expect it. Get used to it. It is going to take up most of your time, money, and effort. Be smart about it. Evidence gathering and analysis are part of every step of the planning process. It is an ongoing process that begins in scoping and ends in implementation. It includes all the iterations of the steps between these two points.

Risk-informed planning is based on the truth as best as we can discern it, and evidence points to the truth. Evidence is proof supporting a claim or belief. It includes facts, science, reliable data, professional judgment, personal experience, expert opinion, and information in many forms. Gathering evidence is the best way to reduce uncertainty in a planning study. It is the PDT's job to account for the uncertainty that remains when decisions are made and to convey the significance of that uncertainty forward to decision makers. The decision makers, then, must take that uncertainty into account during their decision-making. One of the PDT's greatest challenges will be to balance the time, effort, and expense of acquiring more evidence to reduce uncertainty against the risks associated with making decisions without that evidence.

The 1983 six-step P&G planning process suggested that the bulk of the analytical work was accomplished in Step 2. This is too simplistic a view of the analytical requirements of a modern planning study. Data gathering and analysis to reduce uncertainty in support of decision-making is a major component of every planning step. Consequently, it is now depicted as ongoing work throughout the planning process.

Another view of evidence

Data consist of symbols, e.g., numbers on a page. Information is data that have been processed in a useful way. It provides answers to "who," "what," "where," and "when" questions. Applied information provides knowledge, which answers "how" questions. Knowledge leads to understanding, i.e., an appreciation of the "why." Finally, there is wisdom, an evaluated understanding. Adapted from Ackoff (1989)

To understand planning analysis, one must understand scenarios. Scenarios are the stories we tell about conditions of interest to us. In planning, these are usually existing and future conditions. These scenarios provide the narrative logic planners use to frame their analyses. The without condition scenario is the most important scenario used in a study. Because plans affect the future, each plan has a scenario called a *with condition*. Evidence is gathered to flesh out the details of scenarios. Analysis is done assuming a specific scenario is the relevant reality. Much of the most important analysis done in a planning study involves the comparison of selected decision criteria under different scenarios. That is how planners figure out whether their plans make things better or worse and how much better or worse.

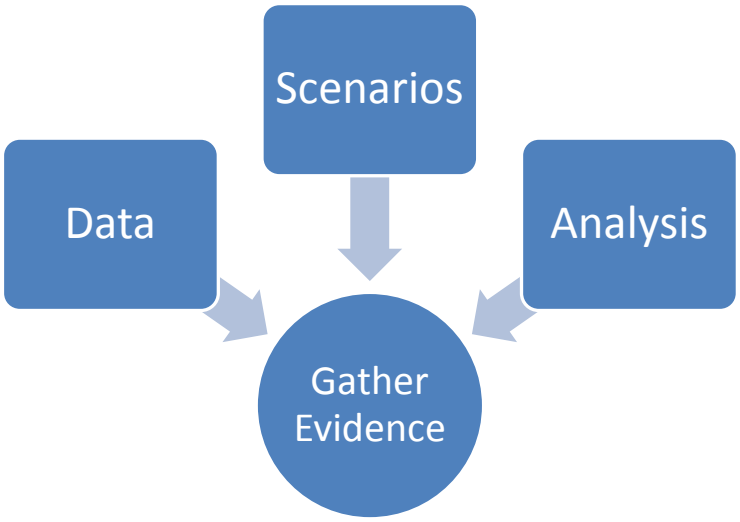


Figure 7.1: Three main tasks comprising evidence gathering.

There are three main parts to the evidence gathering process as seen in Figure 7.1, data gathering, describing scenarios in which analysis is done, and analyzing the evidence. This process produces information and knowledge as it reduces uncertainty, then it illuminates the remaining uncertainty that must be considered for decision-making.

The remainder of this chapter is organized in the following manner:

- It begins by considering decision-making under uncertainty because another great challenge for the PDT is deciding, how much information is enough and how much uncertainty is too much.
- The discussion then turns to data gathering; this includes the kinds of data sources that are available, the types of evidence commonly needed, and how to know when you have enough data.
- Scenarios, like the without and with conditions, describe the contextual settings for the analysis of evidence and they are considered next.
- Once scenarios have been discussed, the chapter ends by considering the analysis of the evidence inside the different scenarios.

7.2 Decision-Making under Uncertainty

The union of risk analysis and planning makes so much sense, it was inevitable. Planning is decision-making under uncertainty. Risk analysis is a decision framework developed specifically for making decisions under uncertainty. Planners never have all the information they want; every substantive decision they make is made under uncertain conditions.

What is the evidence that…

…salmon are disappearing?

…there is a flood problem?

…a bike trail is needed?

…the community opposes that?

…this sits on a seismic zone?

…that will cost too much?

…the super colony will return if water quality improves?

Planning needs to be grounded in reality. Analyses and decisions cannot be based on default positions, consensus, what the boss believes, unsubstantiated opinions, whim, or fancy. *What is the evidence of that?* is an important question to ask repeatedly throughout the planning process. Planning should use the best science, data, models, and analysis that are available. To do anything less is irrational. The practical difficulty is how one interprets *available*. There may be better data or models than you are using, but if you lack the time, money, or expertise to acquire and use them, they are for all practical purposes unavailable. Indeed, deciding how much

data to make available in the course of a study is one of the most controversial aspects of a planning investigation.

In SMART Planning, the PDT is provided a fixed sum of money ($3 million at the time of this writing) and a fixed time period (3 years as this is written) to strategically reduce and manage uncertainty in the choice of a TSP.

We live in a world of resource constraints and we cannot do everything. Thus, we must make choices about what we will and will not do in a planning study. This includes making choices about what evidence will and will not be gathered. Let us consider the implications of this fact with a hypothetical example. Imagine that we have five plans that we are comparing for the purpose of selecting the best plan. One of the comparison criteria will be the first cost of the plan. To compare costs, we need evidence. But how much evidence do we need?

If we literally follow the principle of using the best available information, we could do a design level cost estimate for each of the five plans. This would be time consuming and it may take a substantial part of the entire study budget to get those estimates, leaving little to no money for other analyses. Then, once a TSP is chosen, the details obtained for four of the five plans will be discarded. That is a lot of wasted effort at a very high cost.

Would it make sense to compare the costs with a little less evidence? Perhaps we could use less design detail, perhaps a 30 percent level of design detail would enable us to quantify the differences among the plan's costs, or maybe a 20 or 10 percent level of design detail would be sufficient.

At some point, it would be useful to examine critically the information that is needed to make this decision. If we simply need an order of magnitude of the cost of the five plans, we might be able to get that from a parametric estimate of costs[4]. If all we really need to know is which plan costs the most and which the least, an ordinal ranking of plans may be good enough. This might not require any cost data at all.

As we proceed from the design level estimates for five plans to an ordinal ranking of the five plans, uncertainty increases. As uncertainty increases, the risk of a decision mistake increases as well. For example, with an ordinal ranking, we may falsely assume a plan will produce positive net benefits. Using parametric cost estimates, we might mistake a plan cost by an order of magnitude due to design details overlooked. A 30 percent level of design cost estimate may then result in a Section 902 cost overrun.

Figure 7.2 demonstrates the basic trade-off between the costs of reducing uncertainty through evidence gathering and the amount of uncertainty. A good evidence gathering strategy is to gather only the evidence needed to make the decision before the PDT. Planning is an iterative process. It is possible that the optimal trade-off for early screening decisions might be reflected by point 1 of the figure where the need for detailed data is not great. Once a plan is selected, it might be appropriate to select point 4 for the TSP trade-off. Points 2 and 3 conceptually represent other options for trading off evidence gathering cost and uncertainty. The shape of the curve makes it clear that the

4 Parametric estimates use constants or parameters derived from past cost estimates to estimate future costs. A parametric estimate might use $x per lineal foot of a 10-foot high levee and $y per yard of excavation and multiply these values by rough quantity estimates.

only way to reduce evidence-gathering costs is to increase uncertainty. The only way to reduce uncertainty is to devote more resources to evidence gathering.

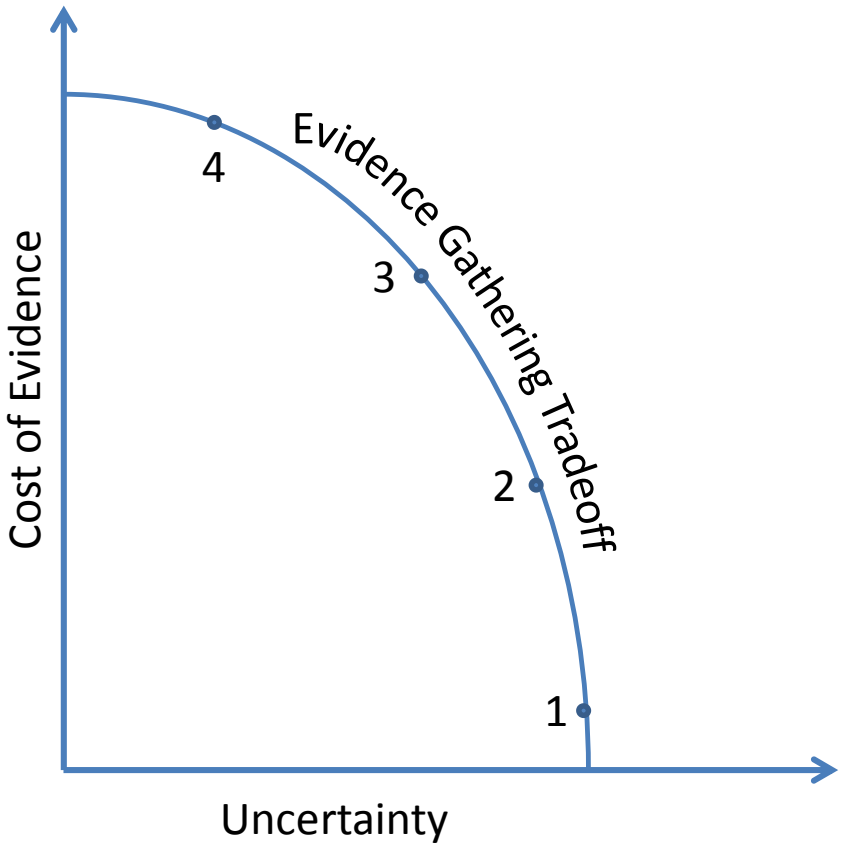


Figure 7.2: Trade-off between evidence gathering cost and uncertainty remaining

Every bit of analytical work the PDT does in an investigation is subject to this trade-off, not just the cost estimation of the example. Thus, making evidence/uncertainty trade-offs an essential part of the PDT's job.

7.3 Data

Evidence, or data as we call it here to distinguish this task from the greater process of evidence gathering, comes from different sources, and some data are going to be more valuable than others. It is convenient to consider three levels of evidence: primary, secondary, and tertiary. Primary sources are the original works of research and raw data gathering. This includes such things as aerial photography, topographic maps, flood damage and other surveys, interviews, observations, questionnaires, behavioral analysis, experiments, field investigations, and any other organized effort to gather information that is not yet available in some form. Primary data are also found in the administrative data of organizations: lockage records, admissions, visitor counts, inventory records, process control charts, rain gage data, stream flow data, and all such routinely collected raw data. Primary sources of information may also be found in letters, videos, interviews, speeches, court decisions, transcripts, government and private databases, and so on.

Secondary sources are interpretations of primary data. Several secondary information types encountered in a planning study are summarized in Table 7.1, prepared by Troy Swanson (2007). Tertiary information sources tend to be interpretations of secondary sources. These are generally found in bibliographies, indexes, and other finding aids like Internet search engines. Primary data tend to be the most expensive, and tertiary data tend to be the least expensive to gather.

Table 7.1: Types of secondary information sources

Information Type	Description	Sample Sources
Scholarly	**Author:** Has some degree of authority in the field; typically has an academic post or is a researcher **Audience:** Other experts in that field **Purpose:** Advances a field of study by reporting new findings or ideas; increases author's authority and credentials in field	**Where to find:** Books, articles in scholarly journals, websites >*New England Journal of Medicine* > *The Explicator* > Research findings on authoritative websites such as PubMed > *Irony in the Short Stories of Edith Wharton* by Charlee Sterling
Professional/Trade	**Author:** Member of a profession or trade but not necessarily a researcher **Audience:** Members of a particular field or trade **Purpose:** Informs, promotes, and generally strengthens the profession	**Where to find:** Trade magazines and journals, association websites >www.ala.org *(American Library Association)* > *Transport Topics* > *RN*
Government	**Author:** Varies (could be government employee, elected official, or expert in a particular field) **Audience:** Varies (could be public, elected official, or government agency) **Purpose:** Generally created to run the government, inform decision makers or inform the public	**Where to find:** Printed government publications and official government websites > *Congressional Record* > *Supreme Court Reporter* > www.nih.gov *National Institutes of Health*
Facts, Definitions, and Statistics	**Author:** Staff writers **Audience:** General public or researchers **Purpose:** presents facts, definitions, and statistics with little explanation or evaluation	**Where to find:** Books and websites but not Wikipedia since it is edited by the public, not a staff. > www.worldalmanac.com *World Almanac* > *Statistical Abstracts* > *American Heritage Dictionary*
Overviews	**Author:** Staff writers, freelance writers, or scholars **Audience:** General public **Purpose:** Provides overviews and background on a subject	**Where to find:** Encyclopedias, dictionaries, other books, websites > *Encyclopedia Britannica* > *About.com*
Entertainment/Popular	**Author:** Non-expert in a field usually with a degree in journalism or training as a writer **Audience:** General public **Purpose:** Presents information in an interesting manner that does not necessarily focus on depth of coverage	**Where to find:** Magazines, websites > *Rolling Stone* > *InStyle* > *Entertainment Weekly* > www.etonline.com *Entertainment Tonight*
News	**News Author:** Non-expert in a field usually with a degree in journalism or training as a writer **Audience:** General public	**Where to find:** Newspapers, news magazines, news websites > *New York Times* > www.msnbc.com

Information Type	Description	Sample Sources
	Purpose: Reports current events in a timely fashion possibly influenced by editorial policy	> *TIME*
Special Interest/Opinion	**Author:** Typically a non-expert in a field but could be an expert expressing his or her opinion **Audience:** General public/people subscribing to a particular point of view **Purpose:** Advances a particular point of view or expresses an individual point of view (the attribution of authority may heavily depend on the beliefs of the reader)	**Where to find:** Books, magazines, websites > *Cult of the Amateur:* by Andrew Keen > National Rifle Association web site http://www.nra.org > American Cancer Society web site http://www.cancer.org
Unsubstantiated or Uncredited Information	**Author:** Unable to substantiate identity of the author or author's credentials do not carry authority **Audience:** General public or unable to determine **Purpose:** Hobby or personal interest	**Where to find:** Websites, information from friends > Personal websites > Blogs > Bogus websites like http://www.malepregnancy.com

7.3.1 Predictable Information Needs

Experience has taught us that several important types of information are going to be needed for any USACE planning effort. First, information is needed to identify, verify, and adequately describe the risks, i.e., problems and opportunities of the study area. A navigation study must document the types of commodities moved, the ships they move in, and the costs of doing so. An aquatic nuisance species (ANS) study must identify the species of concern, their life histories, and life requisites. Flood risk management requires detailed hydrologic and hydraulic studies as well as property damage surveys that will be needed to describe the flood problem in a probabilistic manner. Experienced planners know the kinds of information and analysis necessary for identifying risks for different project purposes.

Second, information is needed to measure your success toward meeting the study objectives and avoiding constraints. If you want to reduce risk to life and reduce social vulnerability in a flood risk management study, you have to be able to measure life risk and social vulnerability. An ANS study to minimize impacts on existing commercial and recreational fisheries requires information to measure progress toward those objectives.

Third, information is needed about the measures and plans identified to achieve the objectives and avoid the constraints. Knowledge of what will work, what will not work and why, together with the relevant descriptive details of the features of the measures and plans considered are all going to be needed.

Fourth, cost information is needed for the proposed solutions. The definition of costs is going to evolve through your investigation. It may begin as ordinal rankings of first costs and end up as a detailed explication of the financial and economic life cycle costs of the TSP.

Fifth, describe the more important effects of a plan. USACE will always be interested in endangered species, cultural resources, and a variety of environmental effects if for no other reasons than the laws that require that interest. There are also likely to be a number of impacts of special interest to your planning partners, stakeholders, and the public that must be described. The specific effects themselves may not be so predictable but that there will be specific effects of interest is predictable.

Paralysis by analysis or extinction by instinct?

Having more information may reduce your anxiety, but, unless it changes your decision, it is not worth the cost of obtaining it.

Ask yourself, "Could this additional information affect the decision?" If the answer is no, forget it. If the answer is yes, then ask how likely is it to change the decision? If the possibility is remote, you may not need the information. Do not pursue information to perfect your decision; pursue it when it might affect your decisions.

Sixth, evidence is needed to measure the decision criteria. Some of these may be included among the preceding categories.

The cardinal rule for gathering evidence is to get what is needed to make good decisions, not what is available or what has been gathered in the past. It may help to assume the role of a storyteller when thinking about the information that is needed. What information is needed to tell a convincing story about the decisions made? If you cannot tell a complete, logical, and easy-to-follow story about what was done, bolstered and supported by the information relied on to do what was done, then you cannot plan successfully.

7.3.2 Appropriate Level of Detail

USACE has, at times, struggled with the appropriate level of detail in a planning study. Reducing uncertainty always has a cost. So what is the appropriate level of detail? The answer is at once simple, elegant, and not terribly pragmatic; the level of detail shall be sufficient to make the decision at hand. Do not pay to gather evidence that is not needed to make a good planning decision. Built into this concept of an appropriate level of detail is an implicit notion that the risks associated with not reducing the uncertainty further have been considered. The standard method for considering the appropriate level of detail is to develop a RR that is owned by the vertical team.

Actively managing risk means carefully looking for indications that a decision to use less data is taking an undesirable turn. When such turns are successfully avoided, it is still necessary to account for the remaining uncertainty that could affect decision-making. There are two alternatives to actively managing study risks. One is to allow chance to determine which risks are realized, the other is to gather more evidence or do more analysis.

The RR[5] provides a structured approach for considering and communicating the potential risks of using less information, i.e., accepting more uncertainty, in a planning study. Planners identify specific actions they will take to advance their planning investigation, which, if conducted with less than complete detail, could affect decision-making, future planning iterations, project implementation, or project outcomes in undesirable ways. Each functional area of the PDT (e.g., geotechnical engineering, economics, hydraulics and hydrology,

5 See http://planning.usace.army.mil/toolbox/smart.cfm?Section=8&Part=4 (Accessed December 30, 2015) for more on the risk register.

archeology, and so on) examines the potential risks associated with accepting more uncertainty in their areas of responsibility. Unacceptable risks must be actively managed to limit their impact on the planning study and future implementation of a project.

7.4 Scenarios

Scenarios are the narrative stories we tell to describe past, present, or future conditions found or expected in our study area. To aid our ability to think about scenarios simply, let us define a *system* as the significant resources, variables, and the relationships among them found in a study area. In USACE planning studies, here are some commonly encountered scenarios:

Avoid This Mistake

Doing some analyses and bundling the results into something subsequently labeled a scenario is a mistake of planning. Scenarios are fleshed out by analysis. Analyses do not comprise scenarios.

- **Existing condition** – describes the system at the time of your investigation.
- **Base year condition** – describes the most likely near term future condition of your system when an implemented project can be completed or is providing significant amounts of its intended outputs.
- **Historical condition** – describes conditions that most likely existed at some specific or target point in the past.
- **Without condition** – the most likely future condition of a system if no additional actions result from your planning initiative. There is usually only one without condition for the entire study.
- **With condition** – the most likely future condition of your system if a specific plan of action is taken as a result of your planning initiative. There is a different with condition for each plan.
- **Ideal condition** – describes a Utopian view of your system with all objectives achieved and constraints avoided, problems solved, and opportunities fully realized.
- **Target condition** – describes a specific set of desired outcome levels.

Before we consider each in turn, let us consider the idea of a scenario in a bit more detail. Scenario narratives describe some mix of resource conditions, assets, events, behaviors, and decisions for a point in time. Uncertainty is a major hurdle in scenario development. A scenario is based on assumptions about how key uncertainties will resolve themselves and how the future could consequently develop. In best practice planning, scenarios are defined and then analysts occupy the shell of the scenario to do their analyses and forecasts that flesh out the specific useful details of a future scenario.

Think of a scenario as a newspaper article style description of the key resources, assets, events, behaviors, and decisions in some specific future. The scenario establishes the basic assumptions to be made about precipitation, land use, economic conditions and the like, all of which can affect hydraulics and hydrology, economic analysis, environmental modeling, and other analysis. Thus, analysts move into the without condition scenario and estimate expected annual flood damages, or

transportation costs, or habitat units. Then, they move into a specific with condition scenario and estimate the values again under the changed conditions of the new scenario. Comparisons of the same values under different scenarios produce differences that can be used to evaluate and compare plans. The scenario provides the plotline that frames the PDT's analytical work. The team then analyzes existing conditions, future conditions without any additional action, and future conditions under a variety of plans. Now it is time to consider each scenario in turn.

What's In? What's Out?

Scenarios should focus on storylines that affect risks, objectives, constraints, plans and their effects, and decision criteria. It is not necessary to address aspects of the future that are traditional or simply interesting to someone.

7.4.1 Existing Condition Scenario

The existing condition scenario describes the system you are interested in as it exists at the current time. It is obtained by inventorying the relevant resources, variables, and their relationships for the study area. Relevant resources, variables, and their relationships are those related to the problems, opportunities, objectives, and constraints the PDT identified.

To facilitate an understanding of these scenarios, the textbox presents an abbreviated and stylized existing condition narrative for a hypothetical deep water port. We will return to this scenario a few more times.

Stylized Hypothetical Existing Condition Scenario

Elkridge Harbor was founded in the late 18th century at the headwaters of the Patasco River and is one of the oldest ports in the Eastern US. Once a bulk cargo port, coal exports are its only bulk cargo now, and its bulk imports are limited to refined oil products at a single pier and raw materials for a sugar refinery in the heart of downtown Elkridge. Over two-thirds of its tonnage is now containerized cargo, with import TEUs (twenty-foot equivalent units) outnumbering export TEU by 5 to 1. Elkridge is the tenth largest container port in the U.S. The port has 50-foot channels into its oil and coal piers and 42 feet at other piers and access channels. The port serves a population hinterland area of 35 million people, including Elkridge, Gotham, Metropolis, and Smallville. The population of this area is growing but only at half the national rate. Elkridge is an aging industrial city with low incomes while Metropolis and Smallville are centers of government activity and somewhat recession proof. They have median incomes well above average.

Several former berths in the Harbor have been converted to waterfront condominiums, with marinas ranging in size from 17 to 141 berths. The harbor has state-of-the-art container-handing infrastructure despite some archaic longshoremen practices that have resulted in work stoppages from time to time. The greatest threat to Elkridge's tonnage is the stability of its importing companies and its overall competitiveness with other East Coast container ports.

Note that there are few quantitative details in the scenario narrative. Details would be provided in the analysis of the navigation problems and opportunities. To estimate transportation costs of existing tonnage, for example, it will be necessary to inventory many conditions, including bathymetry, fleet composition, pilot and ship captain practice, commodities and their quantities, vessel operating cost, time in port, and so on. A sophisticated economic model will be used to combine much of these data in order to calculate transportation cost. Numerous sources of uncertainty will be encountered and addressed along the way.

Scenarios and Uncertainty

Scenarios do not resolve uncertainty; they bound it by providing a plausible possibility of what the future could look like. Scenarios describe possibilities; they are not predictions. Probabilities are not assigned to scenarios. Risk-based analyses can be done inside the scenarios to further characterize the uncertainty that remains in a planning decision.

The scenario is the basic narrative description; it should be as factual as possible but not too detailed. The details follow in the analysis that is done to describe specific scenario conditions. Once a scenario is devised, the PDT then moves into that scenario and lives within it, conducting the necessary technical analysis to produce the desired information. As the scenario changes from the existing condition to a without or a with condition, the analyses will change as well. It is by comparing the results of these analyses across different scenarios that the significant impacts of alternative plans are identified.

7.4.2 Base Year Condition Scenario

In a dynamic system where resource conditions are constantly changing, conditions that exist when the project is finally producing its intended outputs may be more relevant to decision-making than conditions at the time the study is being conducted. This is especially true when conditions are rapidly deteriorating or when opportunities are ephemeral in nature. In these instances, base year conditions may be more informative for decision makers.

Base Year Conditions

Suppose the study is conducted from 2017 to 2020, but the recommended plan will not be producing significant amounts of intended outputs until 2028. In this case, 2028 may be considered the base year.

For many resources, variables, and relationships, there may be no significant difference between the existing and base year conditions. When differences exist, they must be carefully forecasted. Otherwise, it is often sufficient to consider the existing and base year conditions identical.

7.4.3 Historical Condition Scenarios

In some planning investigations, it may be helpful to consider past conditions of the study area. This is especially true in investigations that intend to restore conditions that existed in some particular historical period. There are many studies that seek to correct or mitigate the adverse impacts of anthropogenic or natural disruptions. A good example of this is the Comprehensive Everglades Restoration Plan (CERP), which, in part, seeks to restore some water quantity and quality conditions of 19th century Florida. These pre-disturbance conditions are examples of historical conditions.

People may want to restore beach resources to pre-hurricane conditions or restore wildlife populations or plant abundance to pre-oil spill conditions. There are no hard and fast guidelines for choosing a non-specific historic condition, other than that the condition must be relevant to the planning process. A town may want to restore stream vegetation to what it was like *before*, where before might mean nothing more specific than before it started to disappear. In such a case, the historic condition is nonspecific and it simply refers to a reversal of a generally recognized negative trend in an ecosystem. Historic conditions may serve as a target for planners to aim at in their planning efforts. Historic conditions do not often play an explicit role in planning investigations.

7.4.4 Without a Plan Condition Scenario (The Without Condition)

The single most important scenario in USACE planning is the future condition without a plan, usually called the without condition or the without-project condition. The without condition describes the future of the system if no new actions result from the planning effort. In the language of NEPA, this is equivalent to the No Action scenario. It is important because it is used as the basis for comparison for every plan. If this scenario is not realistic, then neither can the analysis of plan effects nor their subsequent screening be realistic.

No one can say with certainty what the future of a study area will be. The future is not knowable with certainty. Nonetheless, it is common planning practice to select one of the potential futures and identify it as the *most likely scenario* that will prevail if no plan is implemented. Choosing a single scenario is often reasonable when the range of different scenarios or future plotlines is limited. In such a situation, the future is not so much in doubt in broad terms but there may be some very specific conditions that are uncertain. Specific forecasts and analyses of these resources, variables, or conditions often can be adequately handled with sensitivity analysis or risk-based analytical techniques within a single most likely without condition scenario. Nonetheless, the most likely scenario cannot be identified with any confidence if it is the only scenario considered. There is always alternative future without conditions to devise and explore before you can designate one of them the most likely. When it becomes clear that the fundamental direction of the study area's future is in doubt because of significant uncertainties, scenario planning, which relies on multiple versions of scenarios, may be the best way to proceed.

Who Prepares the Without Scenario?

Ordinarily the PDT or some subset of it will build the without condition scenario with input from local experts. The group should at least be multidisciplinary although an interdisciplinary team is the goal and a transdisciplinary team is the gold standard.

Where is the Future?

The natural answer here is that you are concerned about the study area, a watershed, the tributary area to a port, a community, or some such identifiable region. That is most often going to be the right answer. However, the drivers of the uncertainty may be regional, national, global, planetary, or even larger in scope. Climate change has sensitized all good planners to the possibility of factors outside the study area having a significant impact on the future.

How Long is the Future?

When you build a scenario, you are describing the future. How far down the time horizon should the team be looking to construct the without condition? The answer is the scenario should describe a time that is just beyond where you can see to comfortably. Choose a timeframe where the uncertainty becomes a significant concern. This is likely to be less than the 50- or 100-year project life assumed by planners.

Let us revisit Elkridge Harbor. How would different potential without condition scenarios be identified? The simplest way to begin is to simply ask *What is going to change in the future?* What will the problems look like in a couple of decades? If the opportunities are not attained, how will things change? What will the exports and imports be? In what quantities and what kinds of vessels will they move? How will the waterfront change? Will those anchor businesses for the harbor still be here? How will the maritime industry, technology, or labor issues change? What effect will geopolitical events have and how will competition with other ports affect the future. There is no end to the questions that arise.

Ask yourself, what is driving the change(s)? A scenario is not simply an extrapolation of recent trends. Try to identify the two major drivers of change. Suppose in this case that they are national economic conditions and the competitive standing of Elkridge Harbor. Using these two drivers, identify four different without conditions[6] as seen in Figure 7.3.

Figure 7.3: Range of alternative without project conditions

What is a PDT to do? Should they pick the most likely alternative future and do all the analyses assuming it is realized? Do they do a separate analysis for each of the plausible scenarios identified? In general, if the various scenarios are variations on a theme, one scenario will do. These drivers define dramatically different futures for the harbor. Let us imagine that after careful thought it is most likely that the national economy will be strong in this area but that the harbor's competitive

6 Short descriptive "chapter title" names are given to the scenarios. When a single without condition cannot be identified, there would be four different narratives written. A narrative is a newspaper article length description of the key uncertainty drivers for a given scenario. Thus, if the national economy is strong and Elkridge is a weak competitor, they are going to have to try harder in a future environment with many opportunities and lots of competition.

position will be weak. Now, the planner's job is to write the *Try Harder* narrative as the history of the future.

Without Condition Example

The hinterland economy of Elkridge Harbor consistently performs better than the national average. Income and the demand for imported goods continue to grow. A deteriorating quality of life in Elkridge causes the loss of one of its two bulk good import anchor firms. New panamax vessels dominate the East Coast container fleet, and competition from improved harbors at Savannah and Charleston is intense. Trade with Cuba did not materialize. Gentrification of neighborhoods results in increasing pressure to convert industrial waterfront to mixed commercial and residential uses.

The textbox provides a suggestion of how that without condition scenario narrative would go. To illustrate how the scenarios might twist and change, imagine a strong local interest in waterfront real estate for housing and business competing with some marginal maritime uses of that land. The future without action by the planning team is suddenly more complex because the port as an entity could substantially disappear. When the key uncertainties result in very different plotlines for the future, it is important to use more than one scenario, as is done in scenario planning (see Yoe 2012).

Once a without condition scenario is devised, analysts can place themselves conceptually within that scenario and make the necessary forecasts of land use, commodity movements, fleet composition, transportation costs, marine casualties, and the like. Differences among scenarios often can be handled by alternative forecasts of a few key variables, e.g., commodities and fleet composition, rather than by distinctly different without conditions.

The without condition is the one scenario that is used in the evaluation of every alternative plan. It is the one common element in all planning evaluation, comparison and selection analysis, and deliberation. An error in the without condition will be reflected in the evaluation of every plan, and it will carry through the decision-making process. Consequently, it is especially important to develop a realistic, credible, and science-based without condition scenario in every planning study.

7.4.5 With a Plan Condition Scenario (the With Condition)

Each plan the PDT formulates will have a different impact on the study area and, therefore, will lead to a different set of future conditions. The unique set of future conditions resulting from a specific plan is called the *with condition* (i.e., the with project condition). No two with conditions will be alike in all respects as long as the formulated plans are truly different. To evaluate a plan, compare its' with condition to the without condition, which will be the same for every plan. The PDT is looking for differences between without and with conditions values of decision criteria and other important values that make a difference to study area communities and decision makers. This idea will be revisited and developed in Chapter 8 when screening criteria are discussed.

Note that the only significant differences between some with conditions may be the details of the plan to be evaluated. It is possible that some plans will cause essentially the same set of resource conditions, variables, and their relationships.

Multiple with condition scenarios ought to be considered for each formulated plan. A specific plan could reduce future uncertainty to the point that it is reasonable to represent the future with a single representative scenario, i.e., a most likely with condition. Planners would then make their specific forecasts and do their analysis of the plan's effects against the backdrop of this with

condition. When the potential futures with a specific plan in place are markedly different because of uncertainty about the plan's efficacy and performance, multiple with conditions would have to be considered in a scenario-planning context.

Let us revisit Elkridge Harbor once again to consider different potential with condition scenarios. Now the without condition scenario is our reference point. How will the waterfront change with greater channel depth, anchorages, and less risky approach angles in harbor channels? Will those anchor businesses for the harbor still be here? How will the maritime industry, technology, or labor issues change? What effect will geopolitical events have and how will competition with other ports affect the future. You can ask many of the same questions posed for the without condition to characterize how the without condition scenario could be altered by a specific plan. Once the with condition is complete, analysts can move into it and forecast the fleet, the mix, volume, and timing of exports and imports, transportation costs, maritime casualty risks, and the like.

With Condition Sample

The hinterland economy of Elkridge Harbor consistently performs better than the national average. Income and the demand for imported goods continues to grow. Despite a deteriorating quality of life in Elkridge, both bulk operations continue to anchor the port. Improvements to landside loading technology increases the speed of loading enough to secure a new shipping line. New panamax vessels are easily accommodated, and unit train service that results from the increased number of TEU's makes this one of the most cost-effective and competitive ports on the East Coast. Trade with Cuba did not materialize. Neighborhood regentrification has turned away from the waterfront to a renewal of Southpoint Peninsula.

7.4.6 Target or Ideal Condition Scenario

At times, the PDT may be provided with a set of target conditions to meet. These could be water quality standards, mitigation goals, or any number of other target conditions. These conditions may be prescribed by a higher authority, or they may be desired by stakeholders. A target identifies a set of desired outcomes. The scenario that describes these desired outcome levels is the target condition. When the target is realized, the desired outcome levels will be achieved.

Target conditions are more likely to be identified for specific variables or conditions in the study area than they are to be a coherent plotline or logic for the future. Examples of targets include a prescribed level of biodiversity, a water quality goal, a salinity level, a mitigation goal, a tolerable level of risk, or any other appropriate target.

If we generalize and extend the notion of a target, it becomes an ideal scenario. An ideal condition scenario might be useful to develop before the PDT begins to formulate plans. Using the planning objectives and constraints and everything learned about the problems and opportunities during the analysis done early in planning, planners could devise an ideal scenario for the study area. Think of it as a Utopian view of the study area with all objectives achieved, constraints avoided, problems solved and opportunities attained. What does that look like? Describe it and then write that story. It is the ideal condition. Planners then can *move into this ideal condition* to devise and formulate plans that would come closest to making it a reality.

7.5 Analysis

In analysis, PDT members take the data they have gathered and they place themselves in the scenarios they have developed in order to do the analysis required to reveal the information, knowledge, and wisdom needed for successful planning. The first analytical step is to develop the scenario and then the analysts turn to quantifying the scenario. They will quantify the without condition and each with condition scenario identified. Next, analysts compare without and with condition scenarios to estimate the plan effects that will be used to make screening and implementation decisions. Finally, the uncertainty that attends the analysis must be conveyed to decision makers. For examples of the kinds of analytical work that can be done in quantifying and comparing scenarios, see the textbox.

> Planning analysis is not done to satisfy your curiosity, to mimic the structure of an earlier report, to provide other agencies with information they would like to have, to satisfy reviewers, to do primary research, or to design a project for construction. You do planning analysis to support planning decisions.

Analysis usually is done throughout the planning investigation. All the analysis in a planning investigation can be pinned to one or more of the scenarios on which the PDT focuses. With a new study start, these scenarios are usually the existing, without, and with conditions and the evaluation and comparison that is done with them. Examples of common analyses include:

- **Existing condition**
  - Describe the study area
  - Describe the problems and opportunities
  - Identify stakeholders and their concerns
  - Analysis required to describe existing resource and decision criteria conditions
  - Account for uncertainty in existing condition scenario

> **Comparing Effects**
>
> A flood problem is identified and verified in the existing condition. Expected annual damages (EAD) are calculated for the without condition, then EAD are recalculated for the with condition. The difference between these two is calculated in the plan evaluation analysis. That difference, EAD reduced, is compared to the EAD reduced for each of the other plans.

- **Without condition**
  - Describe the without condition scenario(s)
  - Describe future problem and opportunity conditions without a plan
  - Analysis required to describe without condition resource and decision criteria conditions
  - Account for uncertainty in without condition scenario
- **With Condition**
  - Describe the with condition scenarios
  - Describe future problem and opportunity conditions with a plan

- Analysis required to describe with condition resource and decision criteria conditions
- Account for uncertainty in with condition scenarios

- **Plan Evaluation**: Compare Without and with Conditions
  - Identify differences in problems and opportunities attributable to a plan
  - Identify differences in resources and decision criteria attributable to a plan
  - Account for uncertainty in without and with conditions comparisons
- **Plan Comparison**: Compare Differences Among Evaluation Results
  - Analyze the between plan differences in problems and opportunities
  - Analyze the between plan differences in resources and decision criteria
  - Account for uncertainty in the comparison

Fields of Analysis Planners Might Use

Agricultural sciences, anthropology, archaeology, architecture, area studies, biochemistry, biology, botany, business, civil and environmental engineering, computer science, cultural studies, political science, ecology, economics , fish and wildlife management, law, philosophy, endocrinology, environmental science and technology, epidemiology, floodplain management, food sciences, forestry and natural resource sciences, genetics and biotechnology, geography, geology, geomorphology, hydrology and hydraulics, land use planning and management, management and conservation, marine biology, mathematics, medicine, meteorology, microbiology, nanotechnology, operations research, organic chemistry, parks, recreation and tourism, policy and planning, psychology, social work, sociology, soil science, statistics, systems engineering, toxicology, veterinary medicine, watershed planning and management, wood and paper science.

Science is the foundation and the cornerstone for the analytical parts of planning. Planners use the best available science in their analyses so their deliberations and decision-making can be based on the truth of the situation.

Verifying problems and opportunities is often the most scientific part of the study. This is the major part of the initial analytical work. It requires an inventory of current and, perhaps, past conditions in the study area. The methodologies and techniques required will vary from discipline-to-discipline.

Analysis also includes gathering, organizing, analyzing, presenting and explaining the data needed to measure planning objectives and constraints and the decision criteria used throughout the planning process. Analyzing the impacts of plans that do not yet exist is speculative at best, so good analysis pays close attention to what we know and what we do not know, intentionally probing what is unknown and how important it is for analyzing uncertain future conditions.

If there was no uncertainty, there would be no question about what would happen or how and when it will happen. It is because of uncertainty that much of the analysis has to be informed by risk. The key to risk-informed planning is for the entire planning team to be honest brokers of information. Uncertainty is usually greatest in the early iterations of the planning process. Gathering evidence is the primary means to reduce that uncertainty. No matter how much evidence is gathered, however, some uncertainty will remain. When the uncertainty has the potential to affect decision-making, risk-informed planning requires the PDT to purposefully investigate and describe the potential impacts of that uncertainty. In risk-informed planning, the PDT explicitly identifies the uncertainty and then carefully

investigates its potential significance for decision-making. The ultimate purpose of analysis is to support decision-making throughout the planning process.

7.5.1 Comparing Scenarios

Comparing scenarios is an important analytical process. Comparing without and with condition scenarios is the essence of the analytical part of the evaluation process. The effectiveness of a plan is judged based on changes in decision criteria that are observed through scenario comparisons. Table 7.2 shows that if no action is taken, i.e., the without condition, there will be 500 habitat units and $15 million in expected annual flood damages, but there will be no additional costs associated with these conditions.

Risk-based vs. Risk-informed

Risk-based analysis focuses primarily on a narrow set of risk metrics that generally leave little room for interpretation. Risk-based analysis does not include cost, feasibility, trade-offs and stakeholder concerns. In contrast, risk-informed analysis uses a set of performance measures including risk and other considerations, to "inform" decision-making. Risk-informed analysis recognizes that human judgment has a relevant role in decisions and that technical risk information cannot be the sole basis for analysis and subsequent decision-making.

Table 7.2: Example (1) of a without and with condition comparison for habitat units

	Habitat Units	Expected Annual Flood Damages	Cost
Most Likely Without Condition	500	$15,000,000	$0
Most Likely With Condition for Plan A	2,500	$4,000,000	$250,000,000
Differences Attributable to Plan A	2,000	-$11,000,000	+$250,000,000

If plan A is implemented, habitat units increase to 2,500 while EAD are reduced to $4 million at a cost of $250 million. A simple without and with condition scenario comparison shows a change in habitat units of 2,000 and an $11 million decline in expected annual damages with a $250 million increase in costs.

Figure 7.4 illustrates three different methods of comparison for a stylized plan effect where reductions are considered a good thing, for example, life loss or EAD for a flood risk management plan. The simplest comparison is the before and after comparison. This compares a baseline or before estimate of a criterion to the value of that same criterion with a plan in place and functioning. The difference between these two values is calculated in a before and after comparison.

This method does not take into account changes in the effect that would naturally occur over time. The true effects of accelerating and self-attenuating problems are not seen in a before and after comparison. To account for these kinds of changes, the without and with comparison is used in USACE planning studies. The figure shows a problem that grows worse over time under the without condition. The with condition shows the plan's effect takes some time to reach its maximum reduction. The without and with condition comparison yields a significantly different view of the favorable reductions produced by the plan if compared to the before and after analysis. A proper analysis would have to estimate the changes in the effect over time.

Gap analysis is a third kind of comparison. This is predicated on some higher authority or the PDT establishing a target for the effect of interest. For example, a legislative body might establish a water quality standard. Once a target is established, planners try to hit the target by creating a plan that yields a with condition scenario that is closer to the target than the baseline or without

conditions. When the target is ambitious, some solutions may fall short of the target, establishing a gap between the desired level of performance of the plan and its actual performance. Gap analysis is a comparison technique that focuses on the distance between the desired target and the actual performance. The ideal, of course, is to meet or exceed the target. Failing that, the gap should be as small as possible.

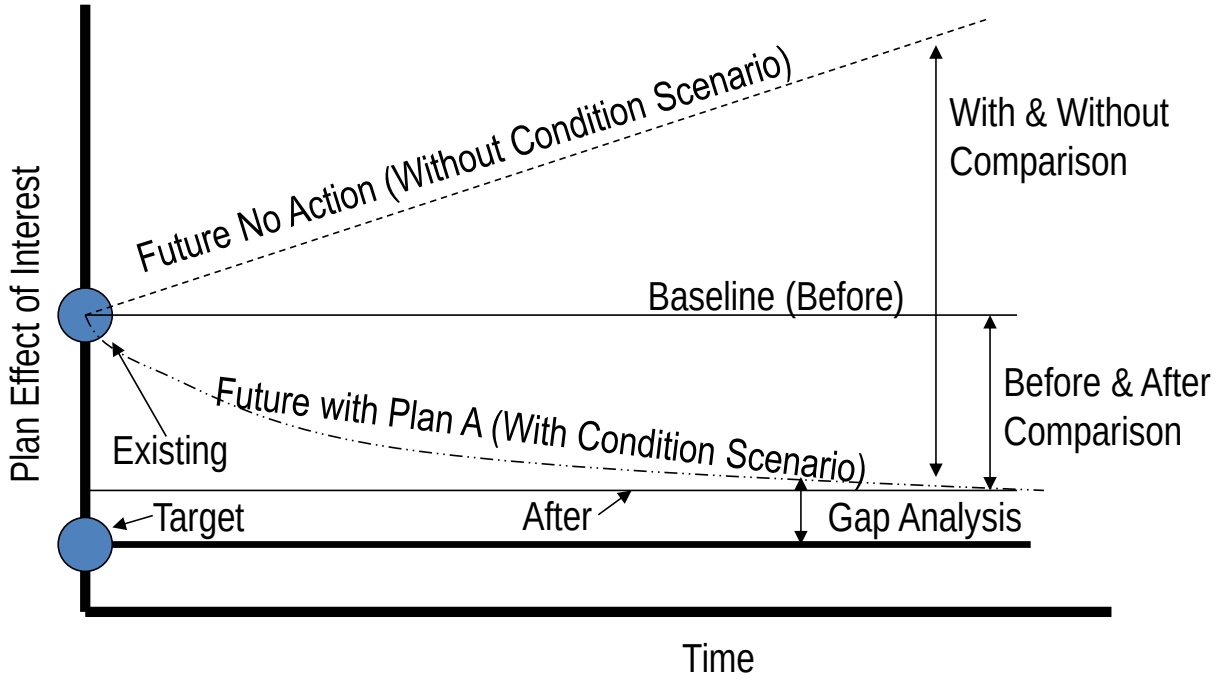


Figure 7.4: Without and with condition scenarios compared

If scenario comparisons are to be useful for decision makers, they must highlight differences in scenarios that make a difference, i.e., differences that are important and that matter to decision makers. In best practice, these metrics will reflect some or all of the planning objectives as well as other decision criteria.

7.5.2 Uncertainty Analysis

Most numbers generated during planning analysis will not be constants. Many of them will not even be facts, in the sense that they are precisely accurate. Most of the analysis done in a planning study produces estimates of uncertain values. When that describes any part of your analysis, here is your mantra, *There is no such thing as the number*. Never use a single value to represent an uncertain value no matter how much pressure you feel to report a single number.

In this context, uncertainty refers to all types of limitations in the knowledge available to planners at the time a planning investigation is conducted and within the time and resources available for the study. As a general principle, planners are responsible for characterizing uncertainty, whereas decision makers are responsible for resolving the impact of uncertainty on decisions. The primary uncertainty information decision makers need is what is the range of possible answers and how likely are they? Uncertainty may be expressed qualitatively using descriptive expression or ordinal scales or quantitatively using individual values, bounds, ranges, or distributions. Planners should

always aim to express overall uncertainty in quantitative terms to the extent that is scientifically achievable to avoid the ambiguity of qualitative expressions (European Food Safety Authority [EFSA] 2015). Examples of quantitative expressions of uncertainty are provided in the pages that follow.

To facilitate the discussion, let us consider a single hypothetical decision criterion, net benefits for four different plans. This calculation is simple in that it is simply total annual equivalent benefits minus total annual equivalent costs. The calculation is complex, however, because there are dozens or even more reasons why the cost and benefit estimates are uncertain. While it is not always necessary to address the individual sources of uncertainty, it is essential to address and communicate the overall uncertainty and the primary reasons for it.

In the recent past, the results of this analysis would have been reported, something like the display in Table 7.3. From that point on, decision makers from the vertical team, through USACE, Department of the Army, and Congress would have used these values as truthful facts when they have been anything but facts.

Table 7.3: Example (2) of a without and with condition comparison for habitat units

Net Benefits for Alternative Plans (Annual Equivalent $)				
	Plan A	Plan B	Plan C	Plan D
Mean	$ 3,999,974	$ 1,200,015	$ 2,999,990	$ 1,900,025

Risk-informed planning demands transparency in the estimation of these values, and the single most important thing to do is to never express these values as a point estimate. Instead, the five number summary can be used as shown in Table 7.4. Notice that the mean is not one of the five numbers reported. The probability of each value below being exceeded is readily apparent. There is a 100 percent chance the minimum will be equaled or exceeded, a 50 percent chance the median will be equaled or exceeded, and no chance the maximum will be exceeded.

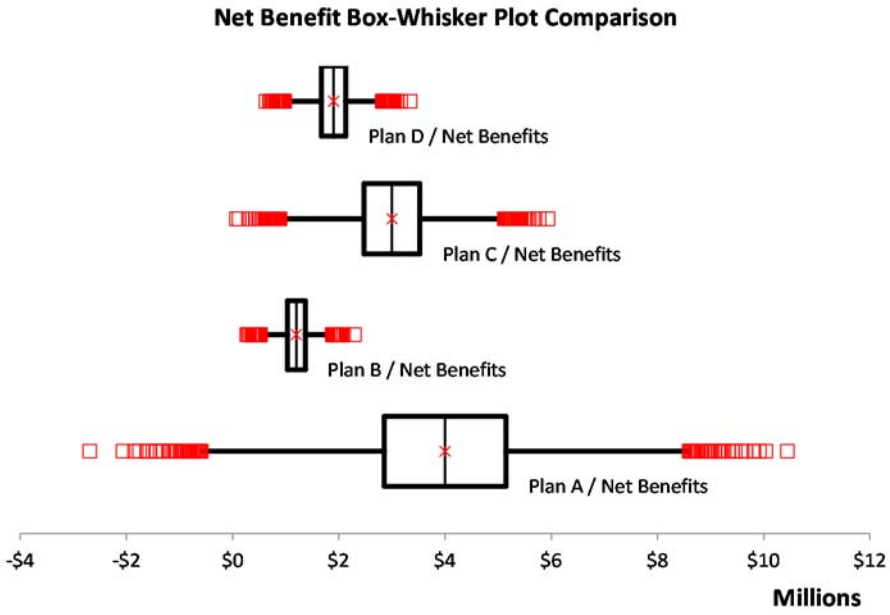
Table 7.4: Net benefits for alternative plans expressing uncertainty with a five number summary.

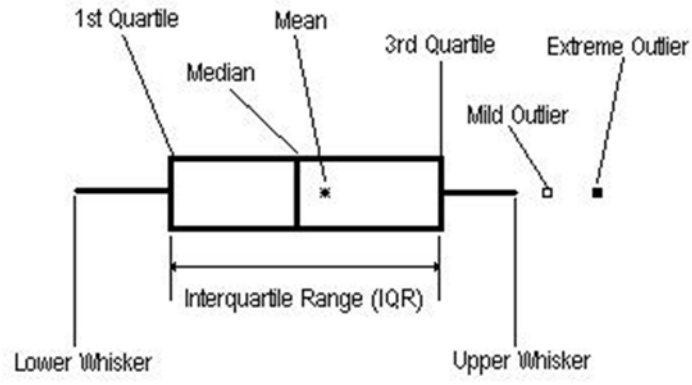
Net Benefit Five Number Summary for Alternative Plans				
Value	Plan A	Plan B	Plan C	Plan D
Minimum	$ (2,690,111)	$ 267,300	$ 71,512	$ 625,328
25th percentile	$ 2,852,921	$ 1,031,313	$ 2,473,757	$ 1,670,590
Median	$ 3,999,840	$ 1,199,990	$ 2,999,968	$ 1,899,979
75th percentile	$ 5,146,140	$ 1,368,612	$ 3,525,996	$ 2,129,246
Maximum	$ 10,444,012	$ 2,293,227	$ 5,938,729	$ 3,346,589

Those who ask for *the number* should be provided with this transparent summary. If they insist on a single value, they can choose it from the summary. There will be legitimate policy reasons for using a single value, but not for reporting a single value that is actually uncertain.

Whenever project costs are discussed, they ought to be described by the five number summary. A single cost estimate can still be chosen from the summary or a distribution to enter into a budget process that requires a single value. Choosing that value, however, should be the decision maker's responsibility.

Figure 7.5 shows the five number summaries for the four plans as a figure. Notice how effectively the plot conveys variation in the data. Plan B has the least uncertain benefits, Plan A the most uncertain.





Whiskers extend to the furthest observations that are no more than 1.5 IQR from the edges of the box. Mild outliers are observations between 1.5 IQR and 3 IQR from the edges of the box. Extreme outliers are greater than 3 IQR from the edges of the box.

Figure 7.5: Box and whisker plots illustrating five number summary values for the net benefits of four plans

The take away point for this discussion is never represent an uncertain value with a single number. To provide a better idea of the uncertainty, move beyond numerical measures and show the data. Figures 7.6 through 7.9 show the net benefit distributions for the four plans. Notice that the

delimiters indicate the probability that net benefits below zero obtain, 0.9 percent in Figure 7.6, as well as the probability of net benefits in excess of $2 million will obtain, 88 percent. These values were selected arbitrarily to provide a couple of specific points for comparison.

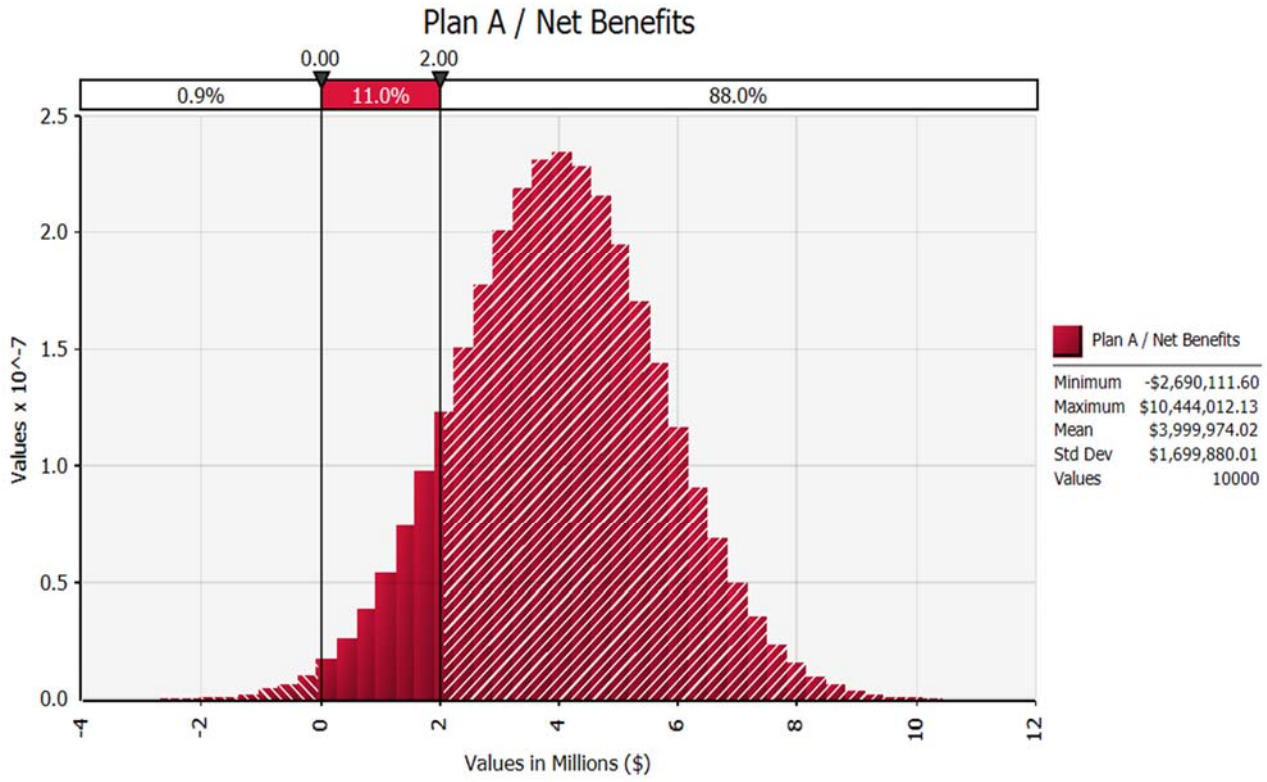


Figure 7.6: Distribution of net benefits for Plan A

The analyst is going to know more about the uncertainty than anyone, so it is the analyst's responsibility to help the decision maker/reader understand the uncertainty. For these four figures, it would be useful to point out that only Plan A has any probability of a negative return and it is small at 0.9 percent. Plan B has very little chance of a return in excess of $2 million. Plan C has the greatest chance of a return in excess of $2 million, with a 90 percent chance compared to Plan A's 88 percent chance. However, Plan A could yield more than $10 million in net benefits while Plan C tops out at $6 million. Plan D is most likely to return less than $2 million in net benefits, but it will not yield a negative return.

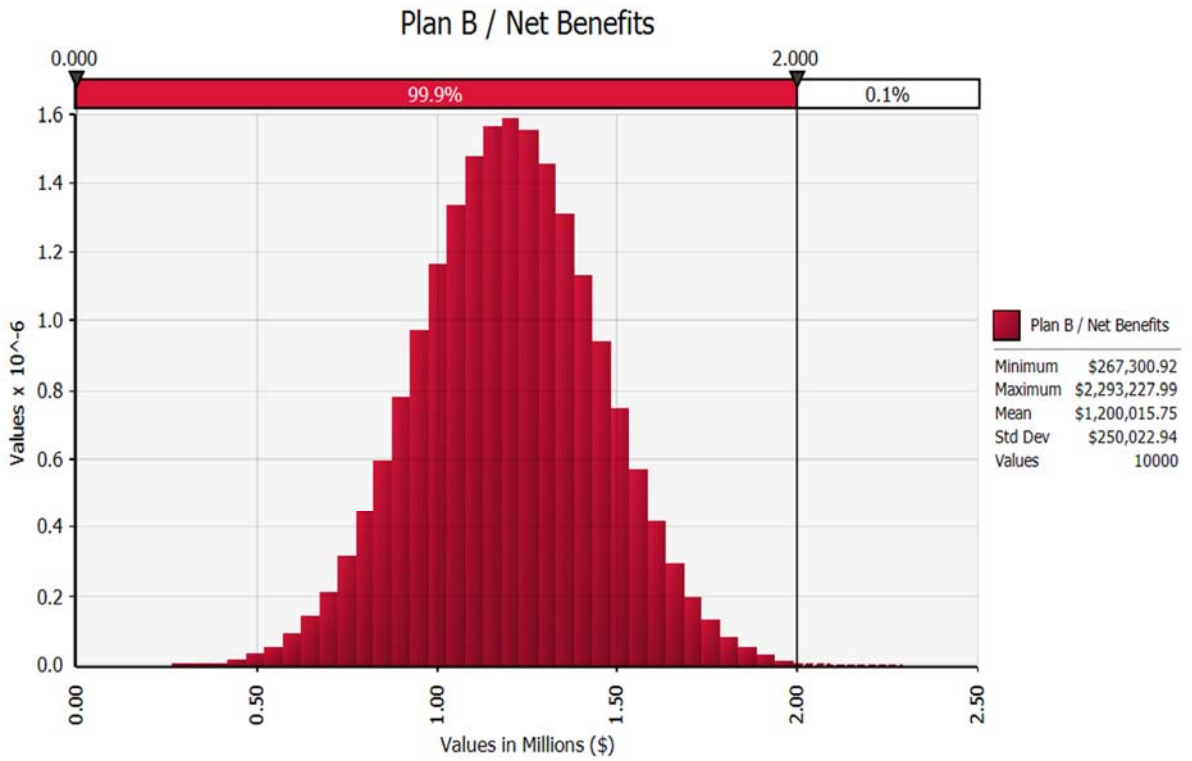


Figure 7.7: Distribution of net benefits for Plan B

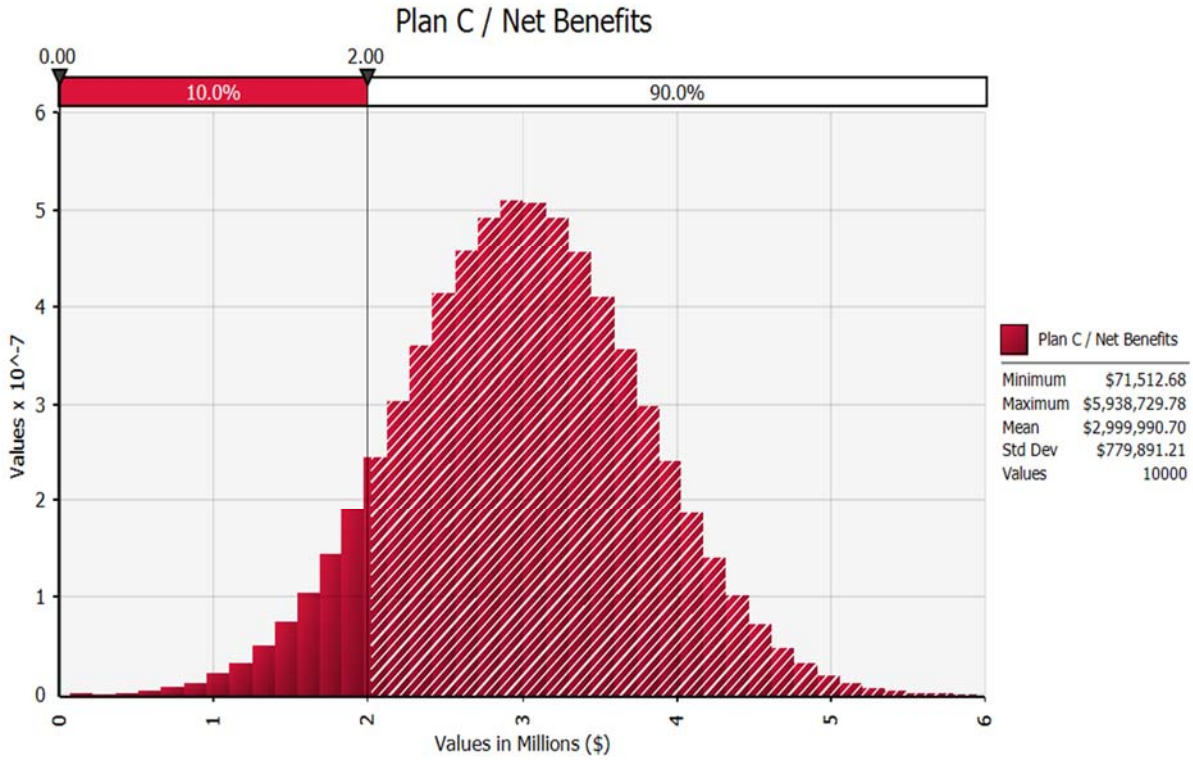


Figure 7.8: Distribution of net benefits for Plan C

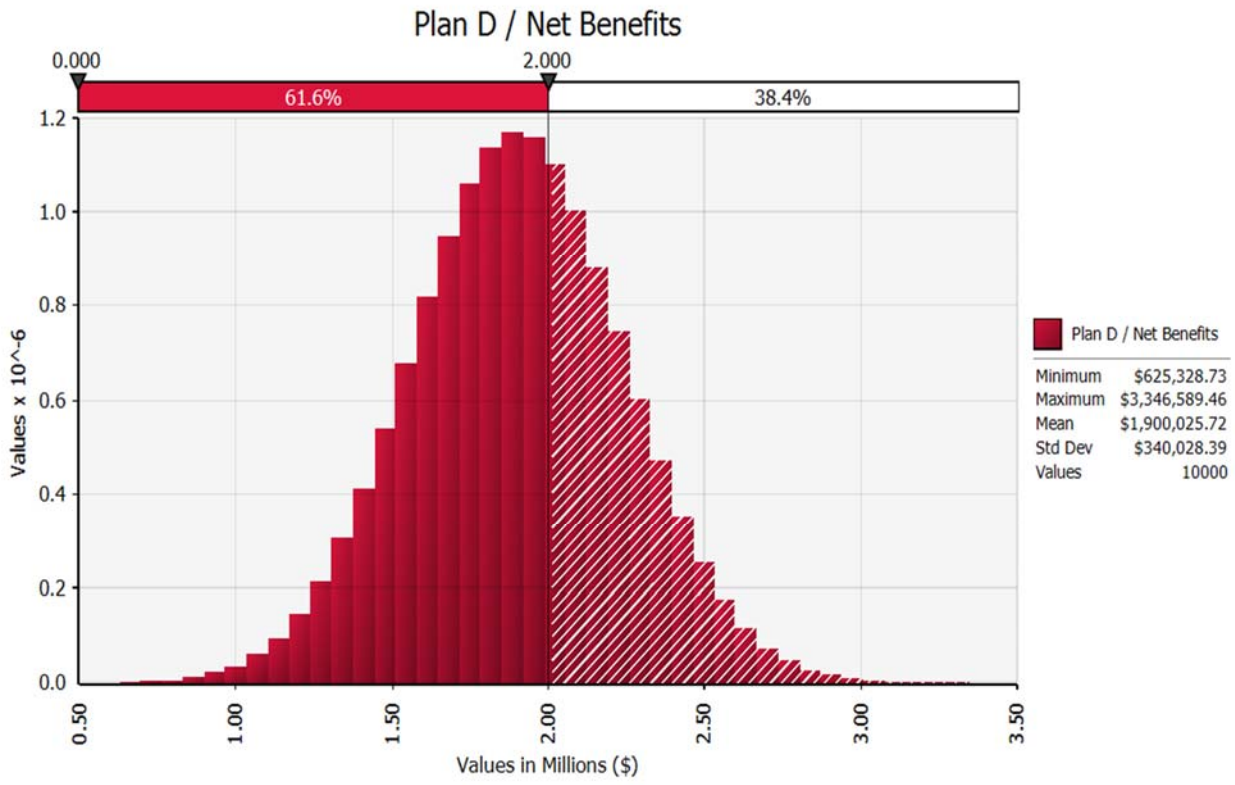


Figure 7.9: Distribution of net benefits for Plan D

Once the data have been summarized numerically and shown graphically, it can be useful to offer decision makers multivariate comparisons of the data. Figure 7.10, for example, compares the net benefits for all four plans in a single figure. Once again, the analysts should help the decision maker wade through the uncertainty in any decision criteria. Note that Plan A is the riskiest plan as measured by the variation in outcomes, i.e., the standard deviation. By the same measure, Plan B is the least risky. However, Plans B and D clearly offer lower net benefits than either Plan A or Plan C. Clearly, Plan A offers the chance of a higher yield than Plan C, but Plan C offers a greater likelihood of net benefits in the $2 to 4 million range.

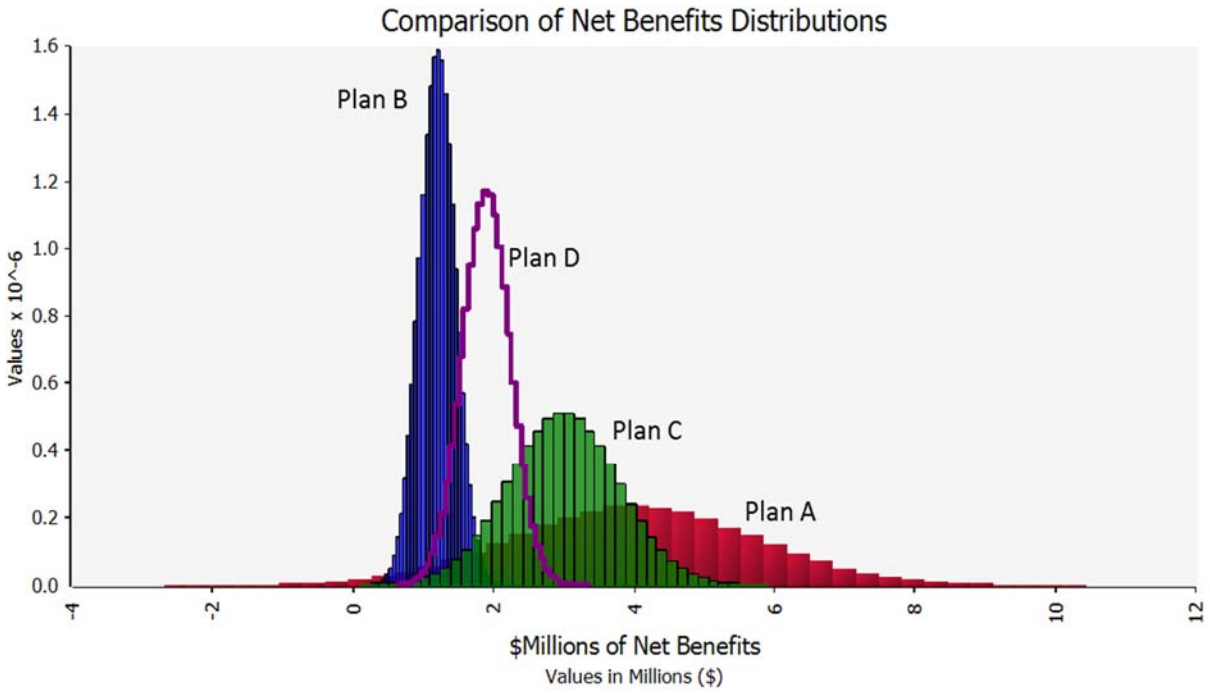


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Figure 7.10: Comparison of net benefit distributions obtained from simulation results

There are alternative ways to present uncertain data, so far the box-whisker plot, individual histograms or distributions, and multivariate histograms have been presented. Figure 7.11 presents multivariate cumulative distribution functions (CDF). A CDF displays the same information in a different form. A histogram or probability distribution shows the shape of the variable's distribution. The vertical axis on these figures has no intuitively useful meaning. The axis measures the density of the data but offers no information about the probability of any values. The CDF, by contrast, has a vertical axis that shows cumulative probability. Think of these values as corresponding to percentiles if that is helpful.

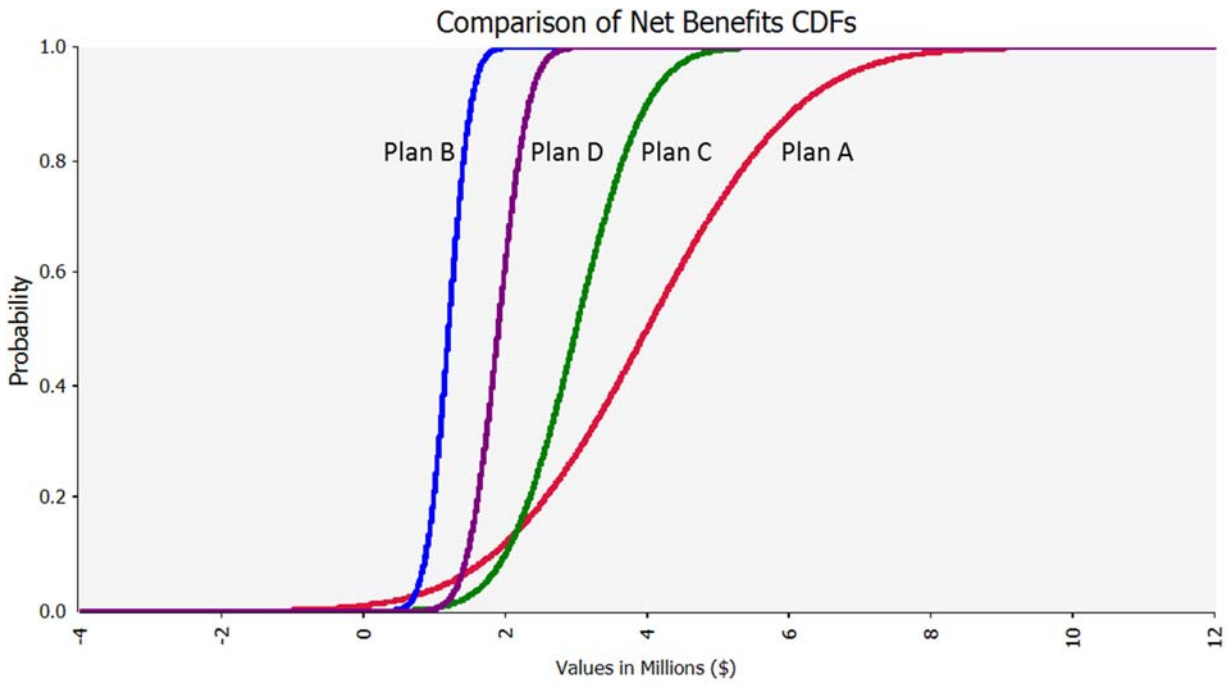

Figure 7.11: Comparison of net benefit CDFs obtained from simulation results

Because greater values of net benefits are preferred to lesser values, the plan with a curve that lies farthest to the right is the preferred plan. Notice that for some of the vertical probability range, Plan C is best but for about .1 and above Plan A is best. It would be best to advise decision makers that if their greatest concern is in avoiding low outcomes, then Plan C is best. However, Plan A offers the best chance of a larger net benefits outcome.

It is not necessary, of course, to use all of these display methods. They are presented to suggest options for avoiding reliance on a single valued estimate of a decision variable like net benefits, which would misrepresent the true nature of the value. Time and experience will reveal the best methods for conveying the nature and extent of the uncertainty in decision criteria.

7.6 Five Points to Take Away

Here are five key points to take away from this chapter.

1. There are three main parts to evidence gathering: data gathering, describing scenarios in which analysis is done, and analyzing the evidence.
2. The purposes of evidence gathering are to discern the truth and reduce uncertainty to support planning decisions.
3. The appropriate level of detail is the level of detail sufficient to make the decision at hand.
4. Scenarios are narrative stories used to describe past, present, or future conditions found or expected in the study area; the without condition is the single most important scenario in a study.

5. Never use a single value to represent an uncertain value no matter how much pressure you feel to do so.

7.7 References

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Chapter 8
Task Two—Plan Formulation

"Think left and think right and think low and think high. Oh, the things you can think up if only you try!" — Dr. Seuss, Oh, the Thinks You Can Think!

8.1 Introduction

Here are a few things to know before leaping into this chapter. The PDT has identified the problems and opportunities then developed objectives and constraints in scoping. It has also begun to verify the problems and develop a view of the future if no new action is taken. The team has been accumulating data and generating information in many forms and formats to reduce the uncertainty in the study. Now is the time to figure as many different ways of meeting the objectives in order to solve the problems and realize the opportunities. It is time to begin to put plans together. This is the most creative and rewarding part of the planning process, and it is everyone's job. Figure 8.1 shows the three principal tasks of plan formulation: identify measures, formulate plans, and reformulate plans. Each is addressed in this chapter, which ends with a discussion of the uncertainty encountered in formulation, but let us begin with some language.

Where do plans come from?

They come from people. They come from moments of inspiration and from months of investigations, analysis, and meetings. They can also come from years of experience or from several iterations of the planning process, but they always come from people.

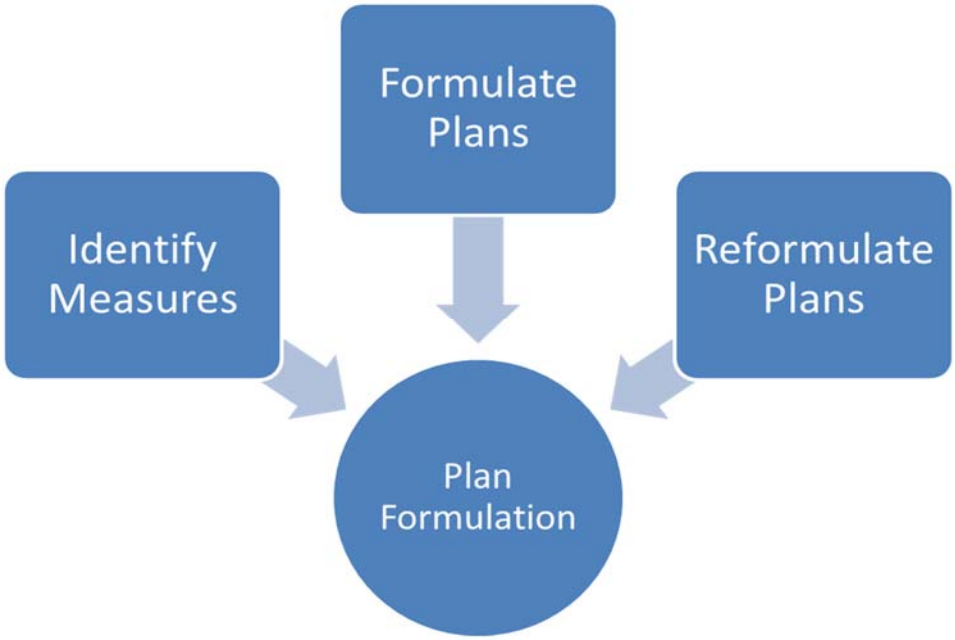

Figure 8.1: Principal tasks in plan formulation

8.2 The Language of Formulation

The Merriam Webster Dictionary defines a plan as, "a set of actions that have been thought of as a way to do or achieve something." That 'something' to be achieved is the set of planning objectives and constraints that define a successful plan. Our working definition of a **plan** is a set of one or more management measures functioning together to address one or more planning objectives. Most plans consist of more than one measure, and they address more than one objective. Good planning requires an array or a set of alternative plans. An **alternative** is one of several candidate plans.

Here are some features: breakwaters, jetties, groins, pumping stations, water control structures, fences, channel modifications, dredging, dams, brush piles, food plots, detention basins, nest boxes and baskets, levees, roosting platforms, floodwalls, and relocations.

Here are some activities: reallocating reservoir storage; modifying water releases; seeding, cutting, and burning vegetation; applying herbicides; buying flood insurance; evacuating the floodplain during floods; building codes; zoning restrictions; one-way traffic on channels; and grazing agreements.

A plan consists of **measures**, the elemental building blocks of plans and the starting points for plan formulation. Sometimes called **management measures**, a measure is a feature or an activity that can be implemented at a specific geographic location and at a point in time to address one or more planning objectives. A **feature** is a physical entity or element that requires construction or assembly on site. It is a *structural* component of a plan. An **activity** is a management action; it is a policy, practice or (a different) way of doing something or managing resources that does not require construction but has a measurable impact. It is a *nonstructural* element of a plan. An activity can be a one-time occurrence, a periodic occurrence, or an ongoing process.

Plan formulation is the process of creating plans that meet objectives and, thereby, solve problems and realize opportunities for gain. Formulation has three basic phases:

- Identify measures that meet planning objectives.
- Combine these measures to build plans.
- Change the plans as necessary.

A **project** is an implemented plan. You can visit a project but you must read a plan. A **program** is bigger than a plan. For example, a program could be a series of plans all over a region or state. The Central Everglades Restoration Project is an example of a program.

Different plans consist of different measures or they combine the same measures in significantly different ways. Different heights of the same levee alignment or different depths for the same navigation channel are not different plans; they are refinements of the same plan. **Refinements** result when you vary one or more attributes of a plan, all other things equal. Some of the more common attributes of measures and plans are introduced below.

Alignment refers to the manner in which features are positioned. There are many ways to configure 1,000 acres of habitat, and levee tie-outs can follow various pathways from the waterway to high ground. The features of a plan may vary in **composition** by using different construction

materials. Flood barriers can be made of steel sheet pile, concrete, or earth, for example. The composition of activities can also vary. Fish can be removed from a disposal area by commercial fisherman, by a paid contractor, or by private individuals in a fishing contest.

The functional **dependence** of measures on other measures can vary. Restoring scallops to a waterway may require the restoration of sub-aquatic vegetation to function and that vegetation depends on salinity control. Other measures may function wholly independently of one another. **Mutual exclusivity** of some measures precludes their use together. Land cannot be managed simultaneously as a fenced and open access area.

The physical **dimensions** of measures or even a plan can vary. The size of a pumping station, the height of a fence, the thickness of a wall, and the width of a channel are a few examples of dimensions. The **duration** of an activity addresses a time dimension. Planners may be able to choose how long to keep an activity up. The engineering **design** can vary for some features of a plan. Interior drainage in a flood risk management levee project can be handled by many different combinations of interior ponding area (storage) and pump station size. The side slopes on a levee or the near shore and foreshore slope of a berm are additional examples of varying design. Different designs and different dimensions can affect the **footprint** of a measure or plan.

When a plan comprises one or more activities, the **frequency** of occurrence for those activities may vary. How often water is released or how often a controlled burn is used to achieve desired outcomes are examples where frequency can vary. Measures and plans may differ in **intensity**, the degree to which a characteristic is present. Wetland creation may plant grasses on 12-inch centers or more intensely at 9-inch centers. Plans can vary by the numbers of duck boxes or watering holes in an area.

What's in a name?

- Name alternatives after geographic features such as neighborhoods, towns, villages, and land forms - "Downtown Plan," "Phelge Lake Plan."
- Consider using targeted species or resources - "Mottled Duck Plan," "Indian Burial Mounds Plan."
- It may be helpful to name a plan after its originator or sponsor - "City Council Plan," "Audubon Plan."
- The plan's dominant measure may suggest a name - "Channel Plan," "Levee Plan."
- Combinations of these methods might also work - "Downtown Channel Plan," "Garden Club Greenway Plan."

Source: Ken Orth, planner

Location is a critical attribute, when choice is possible. Where is the plan? What town is it in? Do you run the floodway through the forest or the agricultural land? Think of **scale** as the size attribute. Size is usually best described by geographic extent. A local plan is very different from a regional or a landscape scale plan. In some cases, scale may be described by volume, density, weight, length, height, width, or other dimensions.

When it is time to implement a plan, what comes first, second, and so forth through completion? **Sequencing** questions may or may not be important in a plan's implementation, but overtopping sequencing is often important in levee projects. Sequences of events can be used to define a different **phase** of a plan. A phase is a distinguishable part of a plan during which one or more elements of the plan are implemented. **Timing** choices sometimes matter. Dredging and beach nourishment activities are often timed to avoid adverse effects on sea life.

Varying some of these attributes of measures may produce alternative plans. Others will result in refinements of a single plan. When you vary the measures themselves, you are most likely to get different plans. Significant differences in alignment, location, and scale may also produce different plans. Variations in the other attributes are more likely to produce refinements of a single plan.

The **NED plan** occupies a special place in this discussion of plan formulation language. This plan is described in the Principles and Guidelines (1983) as follows: "A plan that reasonably maximizes net national economic development benefits, consistent with the Federal objective, is to be formulated. This plan is to be identified as the NED plan." This plan is identified by formulating an array of different plans. The plan from among these that maximizes net NED benefits is identified and then its attributes ought to be refined and optimized so as to maximize net NED benefits as much as possible. The resulting refined plan is the NED plan. For example, imagine a levee plan is identified as reasonably maximizing net NED benefits. Once the measures, alignment, locations, and scale of a levee have been determined, one might examine different heights (dimension), side slopes (design), or materials (composition) in order to **optimize** the attributes of the plan and net NED benefits.

Optimization Is Not Formulation

If you have a flood risk management study that has a single primary feature like a levee, floodwall, or channel and your array of plans includes various levee/wall heights or channel capacities, then what you are doing is optimizing the scale of a single plan. If your navigation plans comprise a single channel alignment with various depths, that is optimization. A formulation process would result in distinctly different plans rather than one basic plan with different attributes.

Planning is **multi-objective**, plans and projects are **multipurpose**. Major (1977) explains the difference:

> "The terms multiple objective, referring to the multiple economic, social, environmental and other objectives of water development, and multiple purpose, referring to the multiple functions, navigation, flood risk management, etc., of water projects, are not synonymous. Purposes can vary and still be aimed at the same objective, and one purpose can fulfill more than one objective. For example, projects for the purpose of navigation as well as those for the purpose of water supply can be designed for the objective of increasing the income of a region, while a navigation project can contribute both to the objective of regional income and to the objective of increasing national economic growth."

Plan formulation should be multi-objective and produce multipurpose plans when it is appropriate to do so.

8.3 Identify Measures

With some language in hand, we can consider a hypothetical progression through the three phases of formulation. Bear in mind that the process is rarely, if ever, this orderly. The first formulation task is to identify measures that meet the planning objectives. This begins by listing and brainstorming as many management measures that could be useful as possible. The varied symbols on the left of Figure 8.2 represent this list of potential measures. The next task is to screen those measures to identify those that are most promising. Screening is a deliberative process that is best served by some simple criteria (it will be covered in more detail in the next chapter). Although there are many candidate criteria, the expected effectiveness of the measure in meeting one or more objective may be the simplest and most direct screening criteria. The output of this phase is a list of screened measures that can be used to achieve the planning objectives, the longer the list the better. Such a list is depicted on the right side of Figure 8.2.

A List of Nonstructural Flood Risk Measures

Moderating Community Susceptibility to Floods:

- Emergency Preparedness
- Flood Forecast and Warning
- Flood Insurance
- Flood Proofing
- Information and Education
- Modifying Equipment
- Relief, Recovery, and Rehabilitation

Reducing Hazardous Uses of Floodplains:

- Building Codes
- Design and Location of Services and Utilities
- Evacuation
- Housing Codes
- Public Acquisition
- Relocation
- Sanitary and Well Codes
- Subdivision Regulations
- Tax Adjustments
- Urban Storm Drainage
- Zoning Codes

Source: http://www.corpsnedmanuals.us/nedmanual.cfml?pg=5&mpg=252

Accessed September 19, 2015

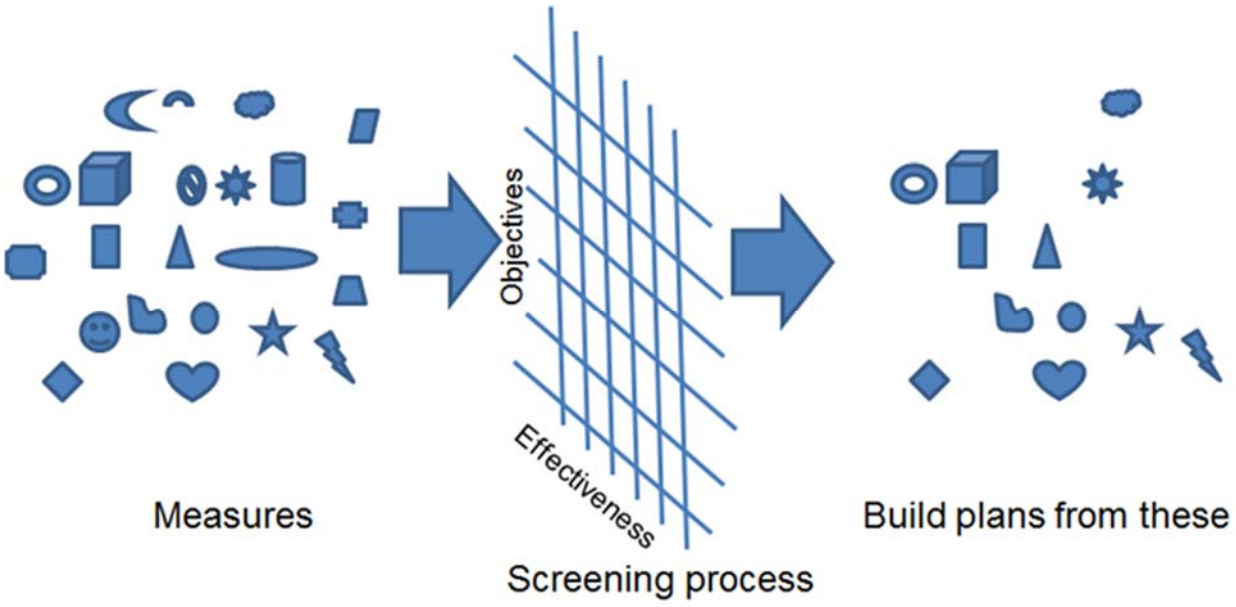

Figure 8.2: Stylized representation of measure identification and screening

Each screened management measures is a viable component of a plan. Think of them as the individual building blocks used to build plans.

Note how the screening task intersects and overlaps with the formulation task. When one planning task bleeds into another, let it bleed.

Expect uncertainty at this point in the study. When a measure is first identified, you begin with no explicit ideas about its attributes. You may not even know how or if it will work at times. The best solution is to embrace the uncertainty, get used to it. As plan formulation advances and some of the uncertain measures survive, you will naturally reduce the uncertainties as the plan is *iterated*. Bear in mind, design level details are not needed to make those planning level decisions.

8.4 Formulation

The second phase, Formulation, i.e., combining measures to make plans, requires the PDT to assemble these measures into a variety of plans. The immediate goal is to develop a variety of combinations of measures that meet different mixes of your objectives to varying degrees of satisfaction. The attributes of the measures are relevant details to consider. Usually, plans are differentiated by different combinations of measures. Occasionally, they may be differentiated by significantly different attributes of a core set of measures. Rarely will a plan comprise only one measure. The output of this phase is a set or array of plans, i.e., potential solutions to the problems and opportunities identified.

Figure 8.3 illustrates this process. Notice there are specific measures identified to meet each objective. This would be discerned when measures are identified and screened. Note that some measures, like the cube and the triangle, contribute to more than one objective. Some measures meet only one objective. There are likely to be different numbers of measures for each objective.

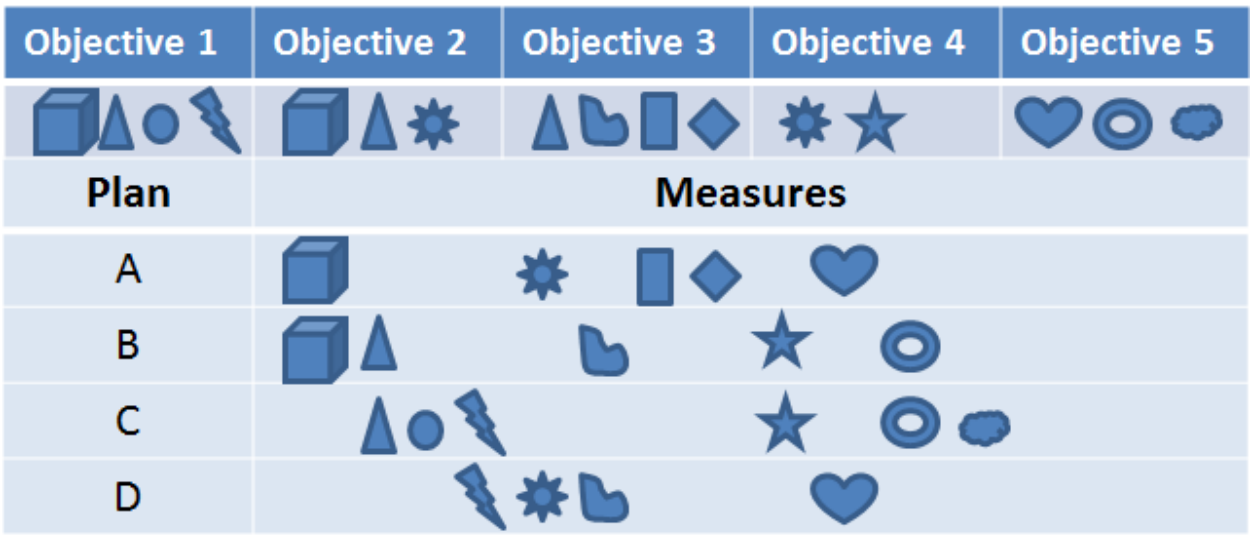

Figure 8.3: Stylized representation of constructing plans from measures that meet objectives

Plan A consists of a unique set of measures that meets each of the five planning objectives. The measures are aligned vertically so true differences in these conceptual plans can be seen. Different plans have different measures although it is not unusual to observe one or more *anchor* measures that show up in every plan. That is not the case in Figure 8.3.

If planning was a 1950's era television show, all the men on the PDT would wear suits and ties with white shirts, and all the women would wear dresses with pearls and high heels, and they would all formulate enthusiastically in a very linear fashion, getting it right the first time. Those shows are notoriously unrealistic and so is such a view of formulation. Figure 8.4 shows how plan formulation overlaps the Deciding and Implementation planning tasks.

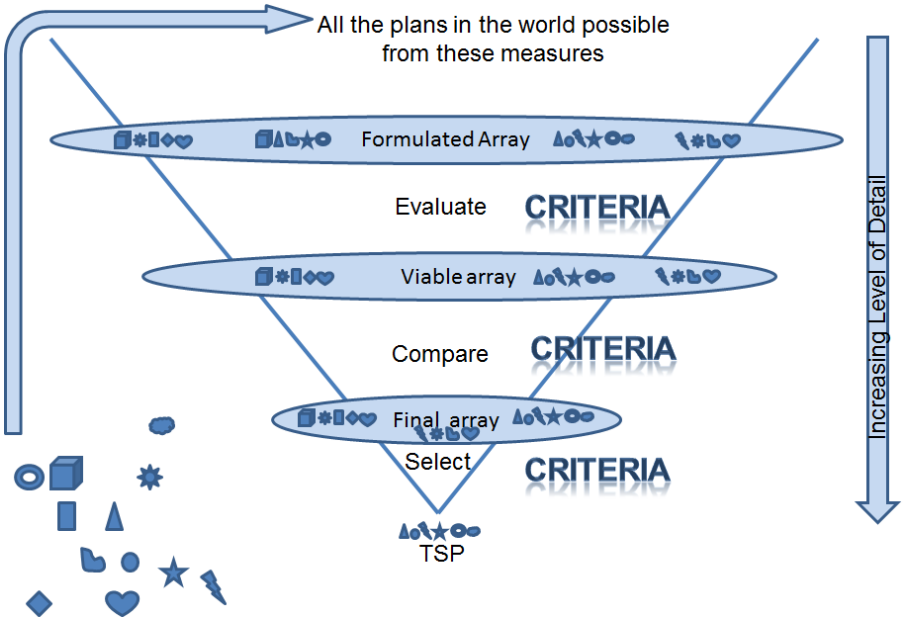

Figure 8.4: Stylized summary of the plan formulation and screening process

The figure begins with the screened measures in the lower left. Conceptually, there are a great many plans that can be formulated from this set of management measures. Only some of them are formulated, and we call these plans the formulated array. They include Plans A, B, C, and D, in Figure 8.3 above; the number of plans is limited to simplify the example. These plans are subjected to a criteria-based evaluation that may result in a subset of the formulated array. In Figure 8.4, Plan B did not survive the evaluation step. That would make it a candidate for reformulation, but let us keep the story simple for now and just drop it from consideration.

Plan Iterations

The first iteration may do little more than identify some measures that comprise a plan. For example, Plan A is a wider and more efficient conveyance channel for Jagger Run, a bike path along the run, and a greenway through town with a walking trail.

The next iteration might generally locate the plan's measures on a map. Someone sketches in the bike path, defines the greenway, guesses at the channel width, and such.

Subsequent iterations would begin to consider plan attributes more carefully as the quality of thought and design detail are gradually increased.

Design detail would not ordinarily be added until a plan is identified as the TSP. A final refinement of the TSP would optimize the plan.

With three viable plans, it is time to compare these plans using the set of comparison criteria. The comparison produces a final array of plans, here assumed to be identical to the viable array, although the relative ranking of the plans may now be different. The comparison step will focus on the differences among the plans that are important to consider. The final step is the selection step, which begins the Implementation task. This results in a TSP, the final decision based on the criteria identified at the outset of the study, as amended by planning iterations. Notice that the level of detail only increases as plans move through these decision iterations of the planning process. It makes no sense to do detailed formulation of all the attributes of many plans when only one will be selected. Best method planning does just enough analysis to make these evaluation, comparison, and selection decisions and then it focuses the detailed formulation and analysis effort on the TSP.

In that 1950's show, everything would have been ready all at once, and the PDT would sit down and do all the plan building at once. Then later they would sit and evaluate all the plans, and then a little later they would compare all the plans.

Figure 8.5, a snapshot in time, shows that plans do not always move forward together. We see one of the plans is already ensconced in the final array even though it has not been evaluated or compared, perhaps because it is favored by the local sponsor or it has been directed by a higher authority. One plan has already been evaluated and is in the viable array. Another plan is currently being evaluated, still another plan was only recently formulated.

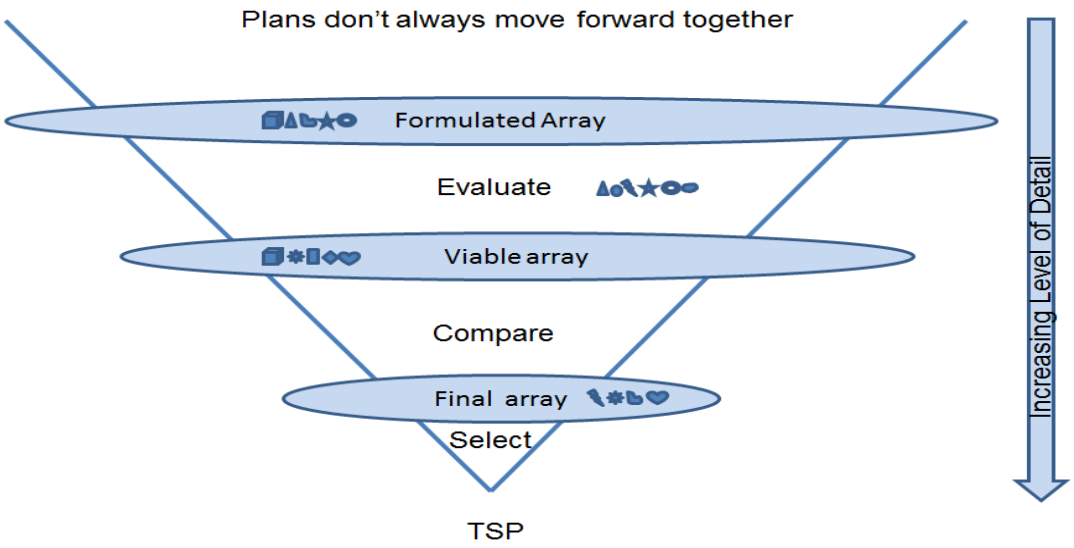

Figure 8.5: Stylized depiction of the messy reality of the sequence of formulation and screening

Most teams will make a concerted effort to complete the formulation stages in an orderly fashion if only to meet Planning milestones[7], but if it does not work that way, do not worry too much, that just makes you normal. Here is what can be expected, each phase of Formulation and Deciding is conducted at least once during a study. Most of the time, you will repeat them many times before you are done, and they are often out of sequence. The tasks usually overlap; you will be identifying new measures at the same time you are changing some older plans. Sometimes, the tasks occur in such quick succession that it is difficult to distinguish among them. Every once in a while, you may find yourself planning in a 1950's TV show; if so, count yourself lucky.

The NED Plan

Here is how you formulate a NED plan. First, you formulate a healthy array of alternative plans, plans that are truly different, not just different scales of the same basic plan. One of these plans will have the largest net benefits. To get the NED plan, you take that plan and optimize its scale and other attributes to maximize net NED benefits. Thus, if you choose the plan that has the greatest net benefits and then refine that plan to maximize those benefits, you have the NED plan. Otherwise, you have something else.

8.5 Formulation Strategies

Formulation, like planning, begins wherever it is. Congress identified the need for a hurricane barrier for Louisiana following Hurricanes Katrina and Rita in 2005. That was the first iteration of a plan. A lot of planning begins with a solution: *The problem is we need a levee!* Sometimes plans appear before the problem is even agreed upon. Every planning process needs one or more rigorous passes through the formulation process.

7 Current USACE policy requires a focused array of plans as a precursor to the Alternatives Milestone. Figures 8.4 and 8.5 avoid this language in favor of the planning concepts depicted.

Plan Formulation has two golden rules. The first is thou shalt have a well-defined scoping process. Clearly defined problems and opportunities and well-developed objectives and constraints is needed. The second rule is thou shalt spend time with others actually formulating plans. You would be a fool to try to impose strict order on such a messy creative process. You would be an even bigger fool to attempt it without structuring the process in some way. This section presents 18 formulation strategies. A formulation strategy is a disciplined way to produce one or more specific plans. Its discipline derives from the structure provided by a more or less orderly sequence of activities. A strategy usually consists of a set of tactics or conditional decisions that shape and guide the development of plans; thus, strategies structure the *how to* of plan formulation. The strategies found below were first described in Yoe (2013). Feel free to use them and change them in any way that fits your planning needs. The first few strategies are the low hanging fruit of collecting the ideas of others before you invent your own plans. They are most useful for identifying measures. By section 8.5.6, the strategies should be producing complete plans.

Who Are the Plan Formulators?

Plan formulation is a creative group activity. Everyone on the planning team needs to be a plan formulator. Some districts are fortunate enough to have a lead plan formulator. That is usually an experienced planner who can help lead the team through this formulation process. However, it does not mean that person formulates plans alone. In fact, everyone involved in the study at any level at all from consultant through stakeholders to marginally interested members of the public is a potential plan formulator.

8.5.1 Do Your Homework

Who has worked on this problem before? Is there a previous report? If so, use the previous report as a starting point. Do your homework and read. Previous iterations of a plan are an excellent source of measures and plans. If no one has studied your problem, perhaps someone has considered problems similar to yours? How did they solve their problems? What measures were considered? Reviewing the measures considered in previous iterations and similar studies is one of the best sources of viable measures.

8.5.2 Ask People

People formulate plans, so ask people how to solve the study's problems and realize the opportunities. Begin by asking those closest to the study, your vertical team. If the vertical team is comprised of the insiders, everyone else is an outsider. It can be helpful to get the views of outsiders. Involve stakeholders directly. Ask them how to solve the problems. Seek out nongovernmental organizations, interest groups, and professionals. Then ask the people who are affected by the problems or interested in the opportunities. What do neighbors, elected officials, shop owners, and bird watchers think will work? Ask your kids, your in-laws, a former professor, reporters, the person next to you on a flight, people in line at the drug store, the homeless. Ask anyone how he or she would solve the problem. Good ideas can come from anywhere, and there are many ways to get information from people. Be creative with whom you ask and how you ask. Ask in private conversations, in the blogosphere, on a wiki, in a webinar, in a contest, on Facebook, via Twitter, and on discussion boards. Provide people with as many opportunities for input to the formulation process as you can.

8.5.3 Checklists

Checklists are your friends when it comes to plan formulation. There is a good chance someone has already thought systematically about a problem like yours. Look for lists of measures. If a good one cannot be found, begin to create it; it can be used repeatedly, especially if shared with other planners. Okay, that is the low hanging fruit; now it is time to engage your mind.

8.5.4 Brainstorming

Brainstorming is a traditional way for teams to identify measures. One simple and logical approach is to take each objective one at a time and brainstorm measures to attain it. Be sure to identify at least one measure for every objective. The most common brainstorming rules are: (1) do not censor or evaluate ideas (corollary: they may be limits to what you can do, but there are no limits to what you can think) and (2) quantity counts (corollary: combine and improve ideas). Use the *3x Yeah* process described in Chapter 6.

8.5.5 Measures that Manage Risks

Focusing on risks rather than objectives provides a slightly different way to identify measures. Here are five generic risk reduction strategies. Consider each problem in turn and identify measures that:

- Eliminate or avoid the context in which the risk occurs
- Modify (transform) or control the consequences of the risk
- Reduce the likelihood of the risk occurring
- Remove objection to the phenomenon that causes the risk to be perceived as a problem
- Transfer the risk to someone else

Solving a Flood Problem

- Eliminate - remove all development from the floodplain
- Modify or transform effect - build a levee or wall to reduce flood damages
- Prevent problem - restrict land use in the floodplain
- Remove objection - educate people to accept flooding as a natural process that provides ecologically significant value in the variability of flows
- Transfer-flood insurance

Use the list this generates to construct plans that provide varying degrees of risk management. Is there a zero risk plan? An acceptable risk plan? A tolerable risk plan? Formulate plans to address your different risks, and then formulate plans to address all your risks.

8.5.6 Find Clues in Data and Models

Verifying the problems and opportunities and reducing uncertainty can provide useful insights into potential solutions to your problems and opportunities. If your hydrologic analysis of a flood problem shows a quick spiking hydrograph, upstream detention basins or even dams would be useful measures. A long and low hydrograph, on the other hand, suggests that rising waters might be more effectively contained by walls or levees. The technical analyses can reveal useful information about the specific nature of your problems and, therefore, potential solutions. A habitat suitability index model analysis may indicate that dissolved oxygen in the stream is the limiting factor. This immediately points toward measures that can increase dissolved oxygen levels in the stream, like aeration schemes and water temperature modifications. Learn from your analysis.

The strategies identified to this point are most useful for identifying measures. The remaining strategies are more plan formulation strategies. The first three techniques that follow are tried and true techniques. Even so, relatively few PDTs formulate in these ways. You will find several more strategies after those. They are field–tested, and they work. Develop a few strategies that work for you and use them.

From Objectives to Measures

Let the planning objectives be to:

1. Reduce acidity of stream
2. Increase diversity of instream flora and fauna
3. Reduce safety hazards due to mine subsidence

Formulation begins by taking each objective in turn and identifying measures that can attain the objective. For example, one can reduce the acidity of a stream through one or more of the following measures that generate alkalinity:

- Compost or anaerobic wetland
- Aerobic wetland
- Open limestone channel
- Successive alkalinity producing systems
- Limestone ponds
- Limestone leach bed
- Slag leach beds
- Diversion
- Inundation/saturation
- Underground mine sealing
- Low head dams to aerate streams
- Stream subsidence closures.

The process continues by developing a similar list of potential measures for each of the other planning objectives. A good planning process will produce one or more viable measures for each of the planning objectives identified. Some measures may be listed for more than one objective. Once you have your lists, start combining measures into plans.

8.5.7 Objectives, Measures, and Plans, Oh My!

This strategy, discussed earlier in the chapter, is simple, logical, and it produces plans. It assures that proper attention is given to objectives and constraints in the formulation process. The strategy straddles the mechanistic and organic worlds of planning. It does have a few mechanical rules: identify measures for each objective, make sure they avoid violating constraints, identify measures that must be used together and use them together, and identify measures that are mutually exclusive and pick one. It is also organic; how you put these measures together and how many plans you build is entirely up to the PDT's judgment.

If objective A is to restore habitat adjacent to the river, objective B is to reduce flood damages, and objective C is to increase urban recreation, the team may formulate single purpose plans, e.g., an

ecosystem plan or a flood risk management plan. There may be multipurpose plans that contribute to all the objectives. Not every plan has to address every objective, but every objective needs to be addressed by at least one plan. Every possible combination of measures will not be considered, so it is important to capture the logic for the plans you do formulate. Write your reasons down as you go; it makes storytelling easier if you do. The one potential flaw with this approach is that if you did not do a good job with your objectives this strategy may not be the most effective way to formulate.

8.5.8 Just Do It

This title says it all. Planners enter a room and start combining measures into plans. There is no algorithm, no structure, and no software. It only takes knowledgeable people gathered in one place and a few ideas to formulate some plans. This organic formulation process draws on the experience, knowledge, wisdom, insight, inventiveness, and synergy of the PDT. Plans emerge through a collaborative work process that is difficult to typify. If there is a traditional formulation approach, this may be it. You show up and muddle through it until you have some truly different plans.

8.5.9 All Possible Combinations of Measures

The most comprehensive way to formulate plans is to make every possible combination of the measures you identified a separate plan. If a good job has been done in identifying measures, then you know the best plan is somewhere in that bunch of combinations. If you carefully account for the dependence and mutual exclusiveness of measures, all the logically viable plans will be generated by this mechanistic approach.

With a small number of measures, this strategy can be completed with pencil and paper. For example, if you have two measures, 1 and 2, there are only three possible combinations: Plan 1 = measure 1, Plan 2 = measure 2, Plan 3 = measure 1+2. Add a third measure, 3, and the total number of plans increases from three to seven. That is a scary jump! The disadvantage of this strategy is that with a lot of measures you are either going to need several pencils and a long piece of paper or some computer assistance. The number of possible combinations (N) is given by $N = 2^M-1$, where M is the number of measures. Ten measures produce 1,023 plans; 20 measures results in over 1 million plans.

IWR-Plan Decision Support Software was developed specifically to assist planners in formulating and evaluating all possible combinations of ecosystem restoration plans. Its input data include the measures identified, an estimate of the output of each measure, and an estimate of the cost of each measure. This software tool relies principally on the use of cost-effectiveness and incremental cost analysis rules to screen the results of a formulation effort from a set of potentially thousands down to a much smaller final array of plans that are called "best buy" plans.

It is available at http://crbweb01.cdm.com/IWRPlan/default.htm

Accessed September 19, 2015.

Mechanistic vs Organic Planning

Mechanistic plan formulation follows an algorithm or a set of logic rules that leads to the generation of plans. The all-possible combinations strategy in the text is the best example of this. Organic formulation is old school; you make it up as you go. Organic formulation is a fluid, growing, and changing process.

Planning is more art than science, however, and there is no guarantee a technologically based approach is going to produce a final array of plans that reflects the artful nuance of an experienced planner who is balancing objectives, constraints, and stakeholder interests. Good plans may get lost in the brute force methods of such a mechanical approach, and new ideas are not as likely to evolve as they are in more organic strategies. Assembling

measures into plans *by hand* can often inspire insight into the ways ideas connect, and this can lead to new ideas a computer program will never imagine.

8.5.10 The Gift Plan

Someone may hand you a plan. Remember to say, thank you. You are doing a study because conditions have attracted people's attention and they want something done. Chances are someone has thought about what they would like to see done. USACE planners may have studies dating back to the 308 Reports of the 1920s and 30s. A local government interest, an environmental interest group, a retired planner, or a county engineer could hand you a plan. Such a plan is a gift, not a curse. You may already have your first plan when the study begins and that assures your own formulation will either top it or end up recommending it.

An influential gift giver might generate pressure to implement a gift plan. When a local sponsor feels very strongly about a plan, it is foolish to discount it. In fact, there could be great wisdom in it. Deconstruct it into its component measures, add them to your lists, and credit the giver generously. If you do, chances are you now have a few measures and a planning ally.

8.5.11 Ask an Expert and Get Out of the Way

If you know an expert, ask him or her to solve the problem. Give him a topographic map, a description of the problems and opportunities, a pencil, a French curve and a straight edge, and then get out of the way. Experts can be the experienced and wise sage who has visited every square inch of the study area over a long distinguished career or she could be the whiz kid that graduated at the top of her class. Experts seem to have the ability to say things like, *We can fence in this area, relocate these buildings, create riffles here, add shade there, and build a winding walking trail through the center*. Voila! A plan is born! Spontaneous plan formulation is rare, so savor it if you ever witness it. The expert's plan, like the gift plan, provides a threshold for the PDT to exceed. If you never can exceed it, then you look like a genius for having asked the expert!

8.5.12 Jagger-Richards Approach

The Rolling Stones were a cover band until Andrew Loog Oldham confined Mick Jagger and Keith Richards to a room and told them not to come out until they had written a song. They did and went on to become fairly well known. This is a strategy to emulate. Pair each member of the PDT with another person, give them a space and as much time as they need to come up with a plan. A 10-person PDT will have five teams of *plan writers* and five plans before long. Change partners and repeat the process.

By the way, if it takes hours to come up with an early iteration of a plan, you are probably getting bogged down in attribute specifics. Nail down the melody and chorus and let the details come later. Do not expect a single formulation iteration to complete a plan.

8.5.13 Cornerstone Strategy (aka First Added)

Sometimes there is a single most important measure in a plan that everyone agrees is essential to a successful plan. Find it first. That measure is the cornerstone. Your task now is to build different plans from this cornerstone. Add measures to meet the objectives not served by the cornerstone. Add measures that provide something for every stakeholder or that craft specific sorts of plans like

the sustainability plan or the recreation plan. If flood risk management is essential and offset levees do that best, then you have your cornerstone.

8.5.14 The Ideal Scenario

What does an ideal future for the study area look like? What would complete success look like? If you can develop some consensus on this vision, then the planners' formulation task is clearly focused. What has to happen to make this future a reality? What are the different ways one could make this future a reality? Identify them, and you are formulating.

8.5.15 Something for Everybody Strategy

It is important to satisfy stakeholders. This is a pragmatic strategy that seeks to do just that. The PDT's job here is to formulate plans that provide outcomes that will satisfy all of the known stakeholders. One approach is to formulate a plan for each stakeholder group. This could lead to a central business district plan, a recreation plan, a fisheries plan, an urban ecosystem restoration plan, and so on, depending on the stakeholders. Now find ways to integrate these plans. Shoot for at least one plan that ensures that each stakeholder group finds some element of interest to them. Then, see if you can do it again.

This strategy produces plans that people can support. It is stakeholder-driven planning. The disadvantage of the strategy is that it is a stakeholder-driven strategy; it gives people what they like and want and that is not always what is needed, especially when stakeholder interests and objectives diverge.

8.5.16 Directed Plan Formulation

Not many of us like being told what to do but sometimes that is a great plan formulation strategy. Federal water resources planning policy currently requires a national economic development plan. You need not wait for a higher authority to direct you; feel free to direct yourselves. Meet the objectives with a nonstructural plan. Develop a high tech plan. Give us an environmentally friendly plan. Show us a plan the farmers can support. Formulate an environmental justice plan. Take care of the vulnerable populations in a plan. All you need is a theme or focal point. Look to stakeholder groups and planning objectives for inspiration. This strategy identifies the specific types of plans you want in the final array and mounts an effort to build those plans.

8.5.17 Mutation Strategy

If you have one decent plan, here is a strategy that works equally well for formulation or reformulation. The basic idea is to mutate the one plan in as many ways as possible. Trigger words can be used to guide the mutation. Examples include subtract, add, transfer, empathize, animate, superimpose, change, scale, substitute, fragment, isolate, distort, disguise, contradict, parody, prevaricate, analogize, hybridize, metamorphosis, symbolize, mythologize, fantasize, repeat, combine, and so on. Pick a word and change your plan in a way that satisfies that word. Subtract something from your plan to make a new plan, then add something to make a new plan, and so it goes.

8.6 Reformulation

This phase might be subtitled *do not throw that plan away just yet*. Sometimes our first effort at putting a plan together is not quite right, and we know it. Other times the screening process will highlight the deficiencies of a plan. Once in a while, the PDT or a stakeholder will see an opportunity to make a good plan better by tweaking it in one way or another. Measures may be added, dropped, or one or more of their attributes can be modified to produce a better plan. Reformulation is part refinement, part reinvention, and part salvage operation; it is an excellent illustration of planning's iterative nature. Reformulation is different from refining and iterating the details of a plan; however, it is fixing or improving a plan.

Reformulate a plan because it…

- Is all wrong
- Makes no sense
- Is not complete
- Is too expensive
- Is not technically feasible
- Causes impacts that must be mitigated
- Is not the least costly way of achieving the outputs produced
- Does not produce as much output for its cost as it could
- Is not acceptable to stakeholders
- Is not in compliance with federal or other policy or legislation
- Lacks economic feasibility
- Fails to address enough of the planning objectives
- Does not adequately solve the problem(s)
- Has been rendered obsolete by changed conditions

After formulation, a plan moves through the Deciding task of the planning process, and a plan may be found lacking during the evaluation or comparison tasks, which can shine a light on the shortcomings of a plan. The PDT can either delete the plan from further consideration or they can try to fix what is broken about the plan. The reasons for eliminating a plan from further consideration can sometimes suggest the kinds of fixes that might improve and save the plan. Not all rejected plans are broken; some are simply not yet living up to their full potential. For example, the bottomland in a water detention basin could also serve as a wetland, and recreational trails could be added. Look for ways to reformulate that will change marginal plans into better plans.

8.7 Formulating for Uncertainty

First, and foremost, you will encounter uncertainty about the measures and plans themselves. You may not know much about the attributes of plans when you first formulate them. This, in turn, will make you uncertain about its effects and impacts on the planning objectives. This is to be expected. The PDT has been given a fixed budget and schedule and the challenge of reducing sometimes vast amounts of uncertainty in a cost-effective and speedy manner. Get comfortable with uncertainty, it is not going away.

Uncertainty can affect formulation. When there are significant uncertainties about the future or if the effects of plans are uncertain, phased implementation of a plan and adaptive management strategies are viable options to consider as part of your plan formulation process. If there are measures that could become rendered unnecessary, ineffective, redundant, or counterproductive, depending on how the future unfolds, your formulation strategy should reflect these possibilities.

Do you build an extensive ecosystem restoration project in a coastal lowland that some experts expect to be underwater within 50 years or so due to sea level rise? Do you build a project to prevent the spread of an aquatic nuisance species that many think is too late to stop? Do you double the width of a navigation channel for traffic increases that may or may not develop? Will changes in water quality and quantity bring back enough birds to require construction of bird islands? Do you purchase land now to maintain the option to use it as a future wildlife refuge? How will cattle grazing affect critical habitat for a sensitive species? How will off road vehicle use and expanding a campground affect sensitive species?

Use Adaptive Management When

- There is a management decision to be made.
- Management objectives can be identified.
- Stakeholders are engaged and committed.
- Information value is high and there is an opportunity to learn more about the problem and measures.
- Uncertainty can be expressed as testable hypotheses.
- A monitoring system can be established to reduce uncertainty.

Source: https://www.doi.gov/ppa/Adaptive-Management Accessed September 19, 2015.

An uncertain future may make you unsure about what the best thing to do right now is. Phased implementation is especially useful when the major uncertainty is concerned primarily with the actual timing of events. Implement measures that are most certain to be effective and phase in other measures as conditions warrant. When the remaining planning uncertainty is not amenable to further reduction through more evidence gathering, it is time to consider formulating plans with phased implementation of its measures.

There may be other instances where the fundamental direction of the future is in doubt. In these cases, adaptive learning and adaptive management strategies may be most useful. The Department of Interior (2009, p. 3) has said:

> *Adaptive management forces stakeholders to confront unresolved uncertainties that can significantly influence management performance. An adaptive approach provides a framework for making good decisions in the face of critical uncertainties, and a formal process for reducing uncertainties so that management performance can be improved over time.*

Adaptive learning comprises systematic and intentional efforts to learn about and reduce uncertainty in the planning process. Adaptive management promotes flexible decision-making that is adjustable in the face of uncertainties. As carefully monitored outcomes from management actions and other events become better understood, they advance scientific understanding and enable managers to adjust policies or operations as part of an iterative learning process. Adaptive management is not haphazard 'trial and error,' it is a science-based process that emphasizes learning while doing.

Adaptive management is not an end in itself, i.e., it is not a true measure or component of a plan. It is a means to make more effective decisions under conditions of significant uncertainty that must be included in the plan during the formulation process. Adaptive learning and adaptive management enable decision makers to maintain flexibility in their decisions while they reduce the remaining uncertainty that exists.

8.8 Five Points to Take Away

Here are five key points to take away from this chapter.

1. Formulation is the most challenging, inventive, creative, rewarding, and fun part of the planning process.
2. Formulation is not always easy, and there are many iterations.
3. There are three phases in the formulations process. These are:
    a. Identifying measures that meet your objectives and avoid your constraints
    b. Combining measure into plans
    c. Changing plans that do not work
4. Everyone on the team is a plan formulator; many people not on the team are as well.
5. Although formulation is a creative process, it is best served by a strategic approach; develop and use one.

8.9 References

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Chapter 9
Task Three—Deciding

"You'll get mixed up, of course, as you already know. You'll get mixed up with many strange birds as you go. So be sure when you step. Step with care and great tact and remember that Life's a Great Balancing Act. Just never forget to be dexterous and deft. And never mix up your right foot with your left." — Dr. Seuss — Dr. Seuss, Oh, The Places You'll Go!

9.1 Introduction

There are three major parts of the Deciding task of planning. First, combinations of measures are screened using four formulation criteria to verify that they are plans, the plans are then evaluated, and the viable plans are compared. These tasks are shown in Figure 9.1. The logical culmination of this deciding process is to choose one plan from the final array as the tentatively selected plan. This fourth task could have been included as the end of the Deciding stage; instead, it is considered the beginning of the Implementation stage. Thus, making planning decisions initiates a more or less continuous process of discernment that bridges from the Deciding task to the Implementation task of planning as shown in Figure 9.2.

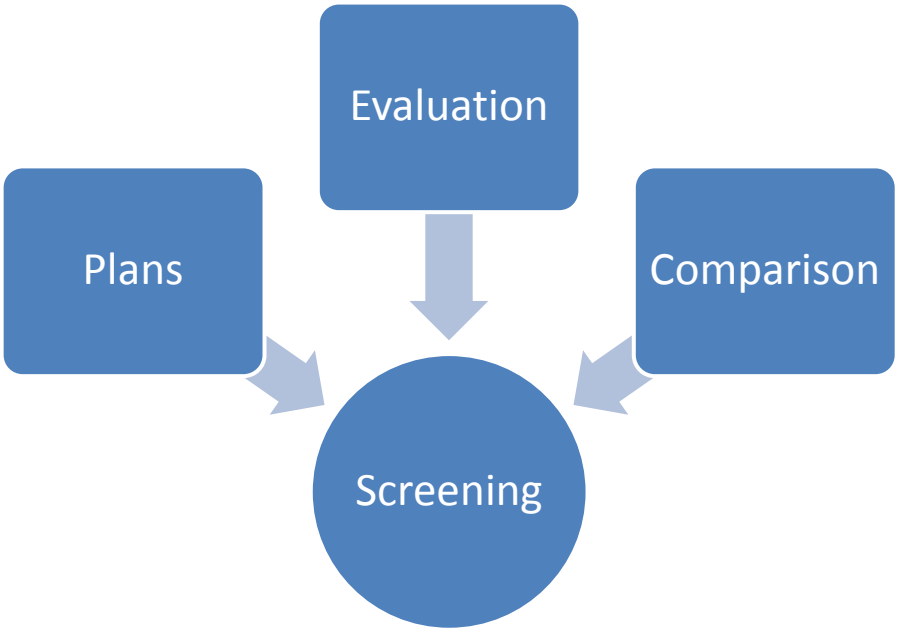

Figure 9.1 : Major components of the Screening Stage of planning

Sorting through the details of the plans and the data that have been gathered may be the most challenging part of the planning process. Deciding encompasses all of steps 4 (evaluation) and 5 (comparison) of the P&G planning process.

In practice, these decision-making tasks are handled in many different ways. They could be accomplished as discrete and separate tasks in a very linear manner. First, a plan is verified, then completed plans are evaluated, then they are compared. In Implementation, one of them is selected as the best plan. Alternatively, these tasks could progress simultaneously. The PDT could be evaluating some plans while comparing others and thinking ahead to selection. The tasks could become jumbled together in a single non-distinct process that defies easy categorization or description. For all these reasons, the process of working through these three tasks is called deciding. The basic idea of deciding in simplest terms is to get from a larger number of raw, possibly unfinished plans to a smaller number of plans, each of which is a viable solution to the problems and opportunities.

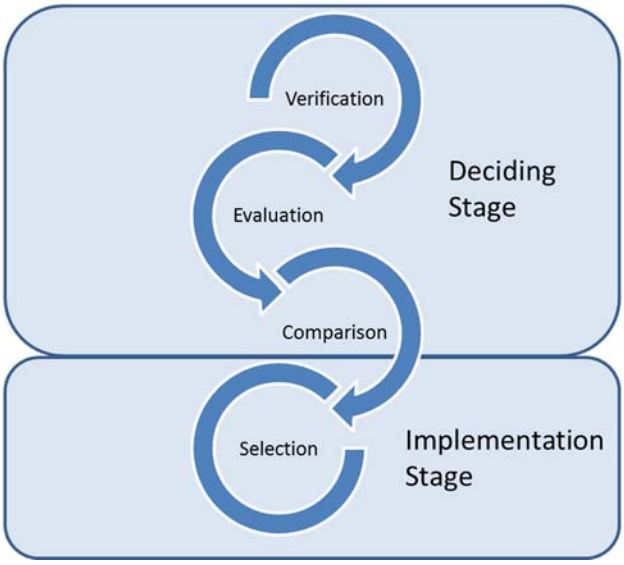

Figure 9.2: Decision-making in the decision and implementation stages of planning

Deciding is usually more iterative than any other part of the planning process, and it iterates in a very ad hoc and often messy way. The team may be zeroing in on a TSP selection when someone comes up with a new idea that sends it back to formulation and plan evaluation. You might be finished with evaluation and find an error in a technical analysis that requires the team to reevaluate all the plans. This stage of a study is the most freeform, so let us begin by considering an ideal process because you will not likely ever see one again outside of these pages.

Screening can begin when the PDT has one or more plans formulated; thus, the first decision task is to verify that you have some plans. There are four parts to plan verification; they are to establish the measure's:

1. Completeness
2. Effectiveness
3. Efficiency
4. Acceptability

Combinations of measures that are complete, effective, efficient, and acceptable are plans, and plans need to be evaluated. The evaluation task has seven major pieces.

1. Identify the evaluation criteria.
2. Prepare one or more with condition scenarios for each plan.
3. Conduct the necessary analysis of the evaluation criteria and other plan effects within the with condition. Do the same for the without condition if this has not already been done.

4. Compare with and without condition values for the evaluation criteria.
5. Assess, i.e., describe quantitatively, where possible, all important differences between the two conditions.
6. Appraise, i.e., judge, the plan's effects.
7. Qualify the plan for further consideration, reformulate it, or drop it from further consideration.

Evaluating a plan can be a lot of work. Do not begin it until you are ready. In time, evaluation will yield a set of viable plans from which to select the best one, but you cannot get from a bunch of individually viable plans to the best plan without comparing them to one another.

The comparison part of screening requires the PDT to systematically look at what is alike and what is different about the plans. The comparison task has nine major pieces:

1. Identify a viable array of plans from the evaluation process.
2. Identify the comparison criteria.
3. Assess differences for comparison criteria using without and with condition comparison results.
4. Find the differences among the comparison criteria effects for each plan.
5. Compare the differences.
6. Contrast the differences.
7. Identify trade-offs.
8. Explain the differences to people.
9. Display the differences with uncertainty.

The best comparison finds differences among the plans that matter to people. It then displays these differences and the trade-offs among plans in a way that enables decision makers and others to see and understand them. That is where comparison stops. It does not say which plan is better or worse; it does not identify a TSP. That judgment is reserved for the last P&G planning step, selection, which is part of the Implementation task of planning. All of these tasks are complicated by the need for planners to pay appropriate attention to uncertainty throughout this process. Characterizing the uncertainty becomes increasingly important the further along one moves in the planning process.

Planners Who Lose Their Way

Engineers like to design things. Biologists make lists of critters in the study area. Economists want to estimate benefits. Analysis is not the purpose of deciding. Deciding is the purpose of the analysis.

Be a good analyst, but do not lose your way. There is a reason for your analysis. You are always trying to make a planning decision. In deciding, the team is trying to determine which of all the plans formulated belong in the final array from which the TSP will be selected. Use all the data you need to do this but only the data you need, not all the data available.

This chapter proceeds by treating planning as a more orderly process than it really is. It begins with an expanded overview of the deciding task, then each of the three major tasks of plan verification, evaluation, and comparison are addressed. If your planning process does not proceed in exactly this way, do not be concerned; that simply makes you normal.

9.2 Another Look at Deciding

Deciding begins where formulation ends, it includes plan verification, evaluation, and comparison, and it carries the planning process right up to the selection step, which starts the Implementation task. The dashed rectangle in Figure 9.3 encompasses all the deciding tasks. Notice that criteria play the role of screens in this stage of planning. Four formulation criteria are used to identify the formulated array of plans; these criteria are completeness, effectiveness, efficiency, and acceptability. Evaluation criteria are used to move from the formulated array of plans to a viable array of plans. Comparison criteria are used to identify the final array of plans. Selection criteria are used to identify the TSP from this final array.

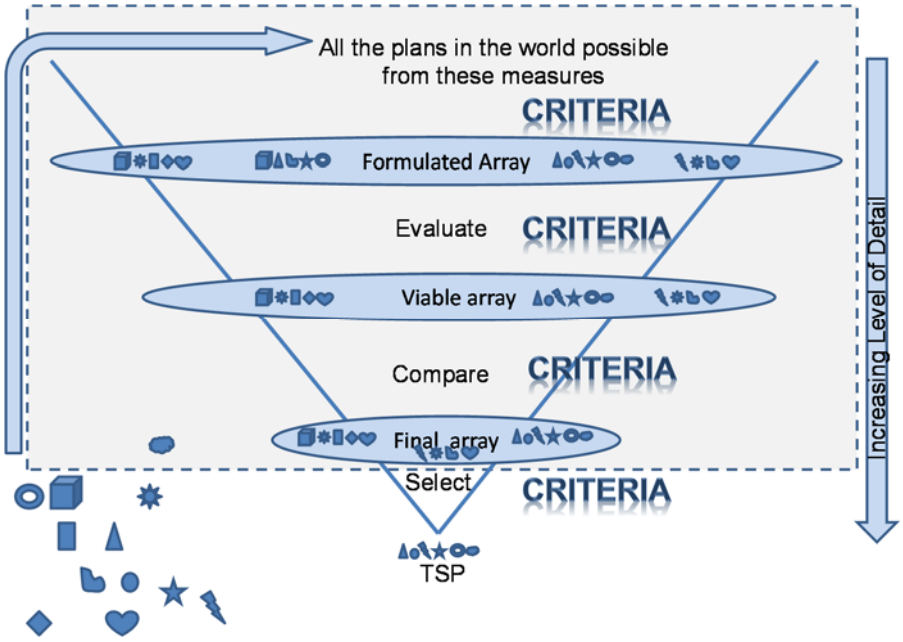

Figure 9.3: Shaded rectangle shows component parts of the deciding task of the planning process

Criteria describe the performance of the plans and their contributions to the planning objectives. Qualitative or quantitative measurements of the criteria reduce the uncertainty about the effects and impacts of the plans. At some point in the deciding process, the decision criteria ought to address all of the planning objectives and constraints. For example, in order for a plan to be effective and acceptable, it ought not violate any immutable constraints, and it ought to contribute significantly to at least some of the objectives. Once you establish that a plan does not violate a constraint, there is no continuing need to include this as a criterion in subsequent decision iterations. New criteria can be expected to enter the process at each screening iteration, whereas some criteria, like cost, may persist through several screening iterations. Other criteria will, like planning constraints and less important objectives, be one and done.

It is essential to good planning that planners be transparent in identifying the set of criteria used for each decision iteration. Figure 9.4 illustrates the idea of criteria used for deciding. Do not take the figure on the left too literally. The various categories of criteria may not be perfect subsets of one another; the circles could be arranged in many kinds of off-kilter patterns. It is also entirely possible that there would be four evaluation criteria and eight comparison criteria, so the size of the circles is not to be taken literally. What the figure does convey is that as the PDT moves deeper into decision-making, uncertainty is reduced and the criteria used become more specific and focused.

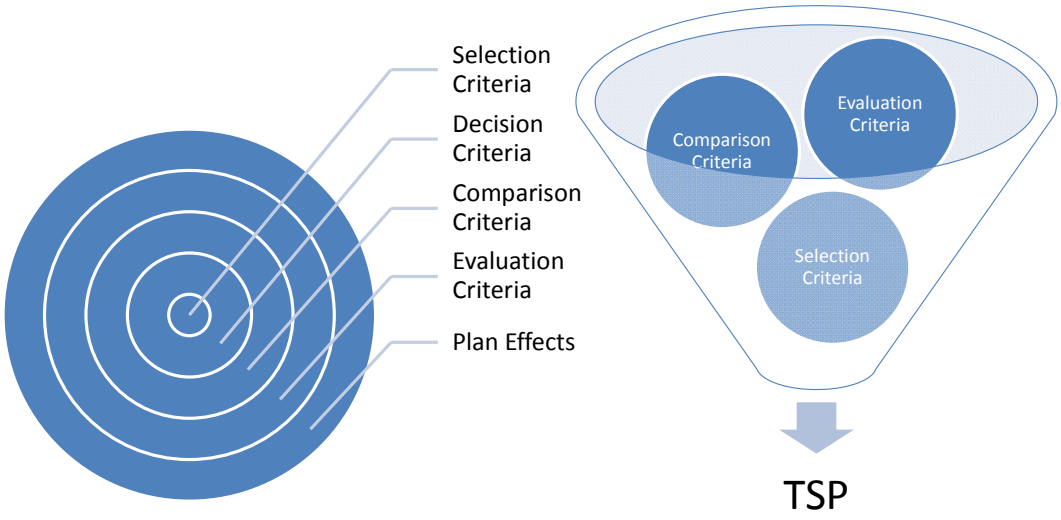

Figure 9.4: Categories of decision criteria used for the planning process

Plan effects are the most inclusive category of potential deciding criteria. These effects potentially include every imaginable impact of the plan on the objectives, constraints, problems, opportunities, resources, conditions, and circumstances of the study area as well as every characteristic and attribute of the plans themselves. Some of these plan effects are used to establish that a set of measures is complete, efficient, effective, and acceptable. Tables showing plan effects can be an effective way to enable stakeholders to find effects of interest to them. These tables, like the Systems of Accounts, are not true decision matrices, however, nor should they be presented as such. It would be highly unusual to use an extensive description of plan effects to actually select a TSP. Once a plan's completeness, effectiveness, efficiency, and acceptability have been established, a great many of the plan's effects no longer need to be explicitly considered in decision-making.

Typically, a subset of plan effects is used to evaluate the plans and a different subset of plan effects may be used to compare the plans. It would be somewhat unusual for the evaluation and comparison criteria to be identical, but it may be even more unusual for there to be no overlap among them.

When the time comes to select the TSP, the decision criteria identified in Scoping may be used, or some small subset of them, the selection criteria, may be used to make the actual selection, much as net NED benefits have been used in recent years. The figure on the right of Figure 9.4 indicates these various categories of criteria. The three categories of criteria shown are all used to move the deciding process along to identify the TSP.

It may also be helpful to note that membership in the sets of plans called the formulated array, viable array, and final array (see Figure 9.3) is not necessarily constant through time. There may be four plans in the formulated array when the team first begins, but by the time the investigation is complete, there may be seven plans that have spent some time in this set. Remember, there are no absolutes in the Deciding task, but there are a lot of useful touchpoints and some helpful guidance. And, oh, by the way, if you happen to stray into Formulation, Evidence Gathering, or Implementation while Deciding, do not be concerned. Follow Deciding where it takes you, its purpose is to enable the PDT to identify the TSP as effectively and as efficiently as possible.

Key Terms

Evaluation consists of assessment and appraisal. Assessment is the quantitative measurement or qualitative description of selected plan effects. It is accomplished using without and with condition comparisons. Appraisal is the subjective weighing of the significance of the assessed effects. Effects can be assessed without appraisal when the intent is to simply describe plan effects without judgment.

9.3 Plan Verification

How do you know when you have a plan? If your set of measures is complete, effective, efficient, and acceptable you have a plan. The first decision iteration examines these four criteria for each candidate plan. This decision may not even be formally executed; it may just be something the team knows about the measures as it moves forward. If a more formal decision is used, it is almost certainly going to be qualitative. In case you want to be a gold standard planner, let us consider these criteria one by one.

Planning Guidance Notebook
ER 1105-2-100

"**Completeness** is the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities.

Effectiveness is the extent to which the alternative plans contribute to achieve the planning objectives.

Efficiency is the extent to which an alternative plan is the most cost effective means of achieving the objectives.

Acceptability is the extent to which the alternative plans are acceptable in terms of applicable laws, regulations and public policies."

Completeness means the plan will work. A complete plan is well thought out. The team has accounted for all the measures and implementation actions necessary to make the plan work. No other actions are required to produce the desired benefits. A complete plan is implementable and workable.

An **effective** plan is responsive to the wants and needs of people. It contributes significantly to planning objectives, and it will solve problems and achieve opportunities. A plan that fails to address the more important planning objectives is not effective. An effective plan does not violate any immutable constraints.

Can you get the same plan outcomes for less cost? Can you get more or better outcomes for the same cost? If either answer is yes, your plan is not efficient. An **efficient** plan does not waste resources. It does not cost more than the value of the outputs it produces and it produces them in a cost-effective manner. A plan that meets a given level of objectives in the least costly fashion or that maximizes contributions to objectives for a given level of resources expended is an efficient plan.

Origins of the Four Criteria

The four criteria suggested for use in the first decision iteration were introduced in the "Principles and Standards for Planning Water and Related Land Resources" of September 10, 1973 as revised September 29, 1980. This policy guidance for federal agencies involved in water resources planning required that alternative plans be formulated in consideration of the four tests of completeness, effectiveness, efficiency, and acceptability.

Acceptability means there is no clear reason a plan will be stopped; it raises no red flags. A plan must be doable. There are many legitimate reasons a plan may be infeasible, including technical, (i.e., engineering or natural world limitations), economic, financial, environmental, social, political, legal, and institutional reasons. Opposition to a plan does not make it unacceptable; that simply makes it unpopular. An acceptable plan is one that can be implemented legally, regardless of its popularity.

If a combination of measures fails to meet any one of these criteria, it is not yet a plan. An incomplete plan will not work. Send it back to formulation for finishing. An ineffective plan is pointless, and an inefficient plan wastes resources. Drop them. An unacceptable plan is a non-starter. The real challenge is in determining thresholds for these criteria. The evaluation is usually qualitative, if not totally subjective. These criteria are likely to be judged on a continuum rather than quantified in any meaningful way. Thus, for a collection of measures to be deemed a plan worthy of evaluation, it must be complete enough, effective enough, efficient enough, and acceptable enough. Measures that fail to meet these criteria should either by reformulated or dropped from further consideration. Measures that do meet these criteria are verified as plans and are ready to be evaluated.

Thresholds will vary. Completeness and effectiveness will be subjected to logical thresholds. Will this collection of measures produce the desired benefits? Yes, means the plan is complete enough. Does this collection of measures make significant contributions to enough of the planning objectives? Yes, means the plan is effective enough. In a NED world, an efficient plan is one with net benefits that are positive. In a changing planning environment, an efficient plan has benefits from all sources that outweigh the costs from all sources. If the total benefits exceed the total costs, a plan is efficient enough. Finally, a plan is acceptable enough if there are no policy reasons that it cannot be implemented.

Once a plan is found to be complete, effective, efficient, and acceptable enough, future decisions about the plan's fate generally rely on more specific decision criteria. It is worth noting, however, that many to most of these criteria are nothing but refinements of these four formulation criteria.

9.4 Evaluation

The purpose of evaluation is to identify which of the formulated plans are going to be viable solutions. That means doing enough analysis to know whether an individual plan makes significant enough contributions to the planning objectives to warrant consideration as the TSP. Plans that could become the TSP move forward. Those that could not are either deleted from consideration or reformulated to correct their weaknesses. The sole exception to this occurs when a plan needs to be included among the final array of plans for policy or other reasons even though it is recognized that plan will not be the TSP.

Evaluation criteria often include things a plan must do to qualify that can then be set aside once it does so. We presume a verified plan does not. Evaluation criteria may include other threshold effects such as not violating the provisions of the Endangered Species Act, the Wild and Scenic Rivers Act, the Clean Water Act, or having a positive impact on property values, tax bases, and the like.

Evaluation Steps

1. Identify the evaluation criteria.
2. Prepare one or more with condition scenarios for each plan (begin second iteration).
3. Conduct the necessary analysis of the evaluation criteria and other plan effects within the with condition and the without condition if necessary.
4. Compare with and without condition values for the evaluation criteria.
5. Assess, i.e., describe quantitatively where possible, all important differences between the two conditions.
6. Appraise, i.e., judge, the plan's effects.
7. Qualify the plan for further consideration, reformulate it, or drop it from further consideration (end second iteration).

To better understand the evaluation process, use the seven steps identified earlier (see textbox). Once the PDT has a plan, evaluation can begin. The very first step is to identify the criteria (evaluation step 1) that will be used to evaluate the plans. In order for a plan to be good enough to become the TSP, it must make significant contributions to the planning objectives. Therefore, it is natural to expect some of the more critical planning objectives to be represented among the evaluation criteria. These criteria will usually include some measure of costs and benefits, significant risk metrics like life safety, and significant adverse or beneficial environmental impacts. The evaluation criteria usually will be identified in a DMP. These criteria identify the minimum set of variables, events, or conditions that will be analyzed as part of the evaluation process. In some studies, they may be a subset extracted from a broader and grander estimate of plan effects. However, if this is accomplished, the output of this step is a list of criteria and the metric that will be used to measure them.

Sometimes evaluation is done individually as plans are verified; other times evaluation begins only after the formulated array is available. This often will be dictated by the pace with which evidence gathering and analysis of the decision criteria proceeds. For example, if the hydraulics and hydrology (H&H) work and damage surveys are sufficiently completed, expected annual damages for flood risk management plans may be calculated as the plans are identified even though cost estimates will not be available until much later. Evaluation is an important decision point, and for transparency, it needs to be based on explicitly identified criteria. That means documentation should say, *The criteria used to evaluate the plans are …*

Although listed as the second evaluation task, describing what the future will look like if a specific plan is implemented can be concurrent with identifying evaluation criteria. Although there is only one without condition[8] for an investigation, there could be a separate and distinct with condition for each plan that is formulated. However, for some different plans, the future scenario is essentially the same. What differs from plan-to-plan is not the future scenario itself but the values of variables and decision criteria within that scenario, e.g., benefits and costs will vary from plan-to-plan although the future will otherwise be largely the same.

The purpose of the with condition is to provide the narrative shell within which the PDT will conduct its necessary analyses of the plan's effects. A good with condition pays special attention to describing problem, opportunity, resource, and other conditions important to the planning investigation. How will the problems and opportunities look different as a result of the plan? Once

8 The exception is when there is a significantly large uncertainty that requires multiple without conditions in a scenario-planning context.

These evaluation criteria come from the Great Lakes and Mississippi River Interbasin Study DMP1.

Life Cycle Cost of the Project: This criterion will be a qualitative ranking of a plan's life cycle costs from 1 to 12, with 1 being the anticipated most expensive plan and 12 being the least expensive plan. The cost of each plan will account for ALL financial costs associated with the plan (implementation, operations/ maintenance, mitigation, induced).

Impacts to Waterway Uses: This criterion will list projected impacts to existing uses of the Chicago Area Water System (CAWS) from implementing the plan, i.e., WQ for impacted Water Quality, FRM for impacts to Flood Risk Management, HS for impacts to human life safety, WS for impacts to water supply, and ECO for impacts to the ecosystem. Significant impacts to uses will be indicated by bolding the impacted use.

Impacts to Waterway Users: This criterion will list the projected impacts to existing uses of the CAWS from implementing the plan, i.e., CNAV for impacts to commercial navigation, NCNAV for impacts to non-cargo (recreational and emergency response) navigation, and HP for hydropower. Significant impacts to users will be indicated by bolding the impacted user.

Required by Law or Policy: This criterion will state whether a plan is required by law or USACE policy with a simple "yes" or "no."

the analysis of decision criteria and other quantities and conditions of interest are completed, these with condition values are compared to the corresponding without condition values to identify differences in them that can be attributed to the effects of the plan being evaluated. If without condition values of selected quantities were not estimated earlier, they should be estimated for evaluation.

Sometimes the without and with condition narratives will look significantly different primarily because of the impacts of a plan. Other times the future scenarios will look largely the same except for significant differences in some specific quantities or decision criteria variables targeted by the plan. For example, the future land use patterns in a floodplain may be the same with or without a plan, and the only significant difference is that expected annual damages and the number of houses inundated by a flow with an exceedance frequency of one percent will vary in the two futures. In another study, the future land use patterns may be significantly different with and without a plan, and these differences could affect population, runoff, economic development, environmental quality, and enough other variables to produce two very different futures scenarios. So the PDT's responsibility is to either confirm that the with condition future is essentially the same as the without condition or to identify a distinctly different narrative description of the future.

There may be times when the future is difficult to describe confidently, regardless of a plan's effects on the study area. For example, study areas that could be significantly altered by climate change, geopolitical events, global economic developments, unanticipated technological developments, environmental disasters, and the like may be so uncertain as to not lend themselves to easy description by one future scenario. Moreover, the future direction of the study area may be relatively unaffected by the height of a levee or the width of a channel. Therefore, understand that the effects of a plan may have from little or no impact on the future to a determining impact. In cases where it is not possible to adequately represent the uncertainty about the future with a single scenario, multiple with condition scenarios may be used for each plan evaluated in scenario

A Simple With Condition Example

Consider a flood risk management study. The without condition calls for a future with repeated flooding, a shaky economy in the floodplain, and deteriorating social conditions in the neighborhoods most frequently flooded. Now imagine a with condition that calls for a levee to prevent flooding. The levee is also expected to lead to gentrification of two of the three neighborhoods. The economy will stabilize but not grow.

A Simple Example of Analysis

Imagine the with condition scenario associated with a levee to reduce flood damages. Hydraulic analyses will have to be redone to reflect the presence of the levees. Expected annual damages, the economic measure of flood damages, must be re-estimated to reflect the presence of the levee and the resulting resurgence of the floodplain neighborhoods. Housing values and tax revenues will change. The job base will differ by the numbers and types of jobs preserved or encouraged by the plan. All of these things must be estimated if they are part of the decision criteria.

planning (Yoe 2012). Most of the time a plan is well represented by a single most likely future scenario.

Once the PDT develops the basic with condition scenario, it is time to *occupy* that scenario and conduct the necessary analyses within the scenario framework (evaluation task 3). As was the case for the without condition, the team must conduct relevant analyses of problem, opportunity, resource, and other conditions in this altered future. Additional analysis may be required for subsequent decision iterations if, for example, comparison and selection criteria differ from the evaluation criteria.

The evaluation analysis usually includes a qualitative or quantitative estimate of the plan's benefits and costs. Positive net benefits are usually necessary for a plan to be considered a viable alternative. Evaluation criteria are essentially qualifying criteria. What must a plan do to warrant serious consideration as a TSP candidate? The PDT has to make these evaluation criteria explicit and then analyze them qualitatively or quantitatively using a without and with condition comparison.

Once the with condition effects of interest are analyzed, it is time to compare the without and with condition scenario values to assess the differences that a specific plan makes (evaluation task 4). There are three basic comparison methods first presented in Figure 7.4 and reproduced in Figure 9.5.

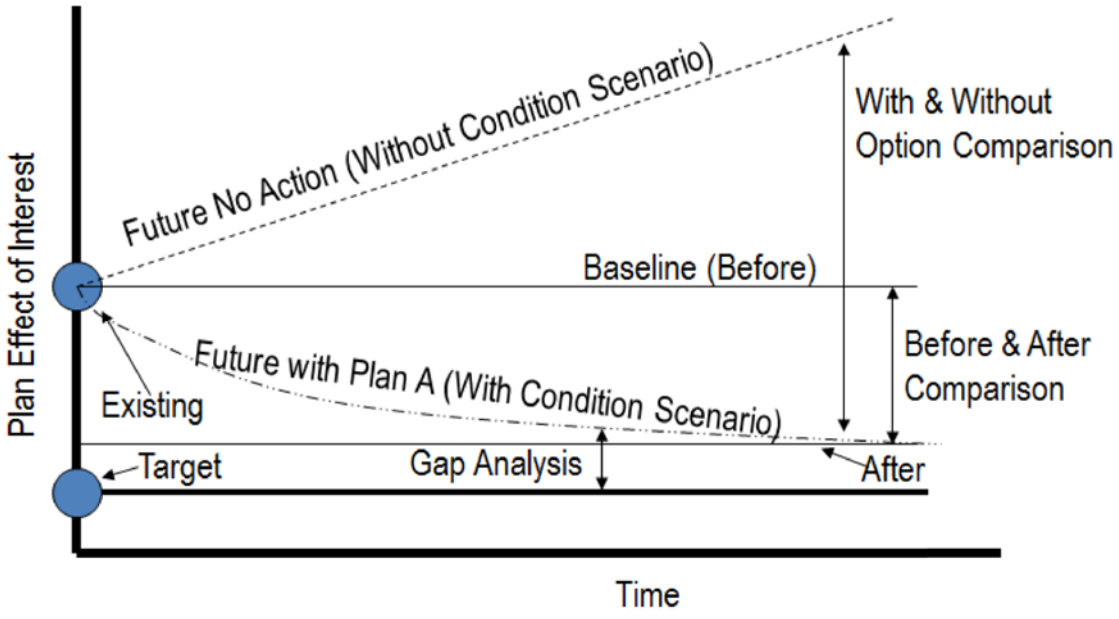

Figure 9.5: Three different comparison methods illustrated

The without and with conditions comparison is used by USACE. An example of a numerical without and with condition comparison (evaluation step 5) is offered in Table 9.1. Wetland acreage has increased due to the plan, whereas expected annual damages, houses inundated, and vulnerable population in the floodplain have decreased. Notice that some of the plan effects like benefits, costs, and benefit-cost ratio (BCR) are not strictly speaking derived directly from a without and with condition comparison. Point estimates are provided in the table to illustrate the differences as simply as possible. In reality, there will be uncertainty attending all of these estimates, and point estimates should not be used. Table 9.2 shows the same sort of information as uncertain values.

Keys to Evaluation

- Identify the differences
- Assess the differences
- Appraise the differences
- Accept or reject the plan

Table 9.1: Without and with condition comparisons and plan effects illustrated with point estimates

Without and With Condition Point Estimate Comparison			
	Without Condition	With Condition	Difference
Wetland Acreage	147	331	+184
Expected Annual Damages	$21.7 million	$5.2 million	-$16.5 million
Houses Inundated	24,873	1,108	-23,765
Vulnerable Population in Floodplain	107,800	10,040	-97,760
Economics Benefits	0	$18 million	$18 million
Economic Costs	0	$15 million	$15 million
Benefit-Cost Ratio	NA	1.2	1.2

Table 9.2: Without and with condition comparisons and plan effects illustrated with uncertainty estimates

Without and With Condition Estimate Comparison With Uncertainty (90% Confidence Interval)			
	Without Condition	With Condition	Difference
Wetland Acreage	147 to 149	331 to340	+182 to 193
Expected Annual Damages Minimum Q1 Median Q3 Maximum	N($21.7M,2.4M)	N($5.2M,1M)	 $7.8M $14.8M $16.6M $18.1M $24.4M
Houses Inundated	24,873	1,108	-23,765
Vulnerable Floodplain Pop. Minimum Q1 Median Q3 Maximum	107,800±10%	10,040±3%	 96,004 101,363 106,745 112,144 117,533
Economics Benefits Minimum Q1 Median Q3 Maximum	0	 $7.2M $16M $18M $20M $27.3M	 $7.2M $16M $18M $20M $27.3M

Without and With Condition Estimate Comparison With Uncertainty (90% Confidence Interval)			
	Without Condition	With Condition	Difference
Economic Costs	0		
Minimum		$15.0M	$15.0M
Q1		$16.6M	$16.6M
Median		$17.8M	$17.8M
Q3		$19.1M	$19.1M
Maximum		$23.7M	$23.7M
Benefit-Cost Ratio	NA		
Minimum		0.4	0.4
Q1		0.9	0.9
Median		1.0	1.0
Q3		1.2	1.2
Maximum		1.6	1.6

Table 9.2 shows a range of values for wetland acreage because these were estimated using professional judgment rather than probabilistic methods. The number of houses inundated is not considered to be an uncertain value in this example. All of the other criteria were estimated using Monte Carlo simulations to characterize their uncertainty. The results are shown using a five number summary, which consists of the minimum, first quartile, median, third quartile, and maximum values.

Communicating the uncertainty in estimates of critical decision criteria has been a growing risk assessment practice. Using the uncertainty to consider how decisions might change has been slower to develop. Consequently, it is important to get the vertical team, interested parties, and decision makers familiar with understanding the uncertainty that does exist. The single best way to do that is to avoid reliance on a single number for any decision criteria when that value is uncertain.

Table 9.1 facilitates the false precision of planning analysis by presenting point estimates of values that are far from definitive. Table 9.2, by contrast, forces the reader to see the uncertainty. The probability of the various values presented are implicit in the five number summary. One hundred percent of all values are equal to or greater than the minimum, 75 percent are greater than the first quartile (Q1) value, 50 percent exceed the median, 25 percent are greater than the third quartile, and none is higher than the maximum.

A plan qualifies as a viable solution when the without and with condition differences make a difference, i.e., they show effects that are desirable. Appraising the assessed differences (evaluation step 6) is a judgment task that amounts to subjectively weighing the objective assessment of the differences. Reference points make this subject appraisal a little easier. A reference point may be a formal or informal target or threshold established within or outside of the planning study. A BCR of one or more is a long established threshold and reference point. The local sponsor may informally establish maximum costs of construction.

Deciding Criteria

Formulation criteria differ from evaluation criteria, which may differ from comparison criteria, which may differ from decision criteria, which may differ from selection criteria. There may be criteria like costs that appear in more than one set of criteria. Each of the planning objectives probably ought to appear at least once in one of these sets of criteria.

When explicit thresholds (or targets) for plan effects exist, state them. Less formally, without condition scenario values provide convenient reference points. It can be informative to show the with condition increasing or decreasing a without condition value of interest.

Evaluation requires planners to weigh plan effects like those in Table 9.2 and then to subjectively determine whether the plan is a viable TSP candidate or not (evaluation step 7). Planners have been known to establish their own more or less arbitrary thresholds for some effects. For example, they may decide a plan must reduce the vulnerable population in the floodplain by 70 percent or more to qualify as a viable solution. If there are no explicit thresholds or rules for appraising the assessed effects of a plan, then planners should describe how they judged the assessed effects to qualify a plan for further consideration as a solution. This task is made more complex by uncertainty. A plan that is expected to reduce the vulnerable population by 70 percent or more is good, but is a plan with a 50 percent chance of having a BCR of one or less desirable or not?

If you seek the decision rule to resolve these difficulties, let us not delay the heartbreak. There is none. This is a decision the PDT will have to struggle with when honestly confronting the uncertainty in the decision criteria. Plan evaluation can end in a number of ways.

1. You may not have a plan yet. The bundle of measures may be incomplete, ineffective, inefficient, or unacceptable. These candidates are returned to the formulation step for finishing or fixing, or they are dropped from further consideration.

2. Plans appraised as having desirable effects on the future and acceptable levels of uncertainty are qualified for consideration as the TSP in the comparison decision.

3. Plans appraised as having desirable effects and unacceptable levels of uncertainty are returned to the evidence-gathering step to either reduce the uncertainty or to develop more effective means of addressing it.

4. Plans appraised as lacking in desirable effects can be returned for reformulation with insight into where and how desirable effects ought to be increased.

5. Plans appraised as lacking in desirable effects can be dropped from further consideration; they are disqualified if they cannot be modified to produce enough desirable effects to warrant consideration as a viable plan.

All plans must be evaluated and eventually qualified or disqualified. Remember, evaluation may occur piecemeal over time as plans are formulated, or it can occur all at once when the formulated plans are sufficiently developed and the necessary evidence is available. At the end of evaluation, it should be the PDT's best judgment that every one of these remaining plans is a viable candidate to become the TSP; thus, an array of viable plans is the output of the evaluation step. The road to the TSP continues in the comparison task of the deciding process.

9.5 Comparing Plans

In order to choose the TSP, the PDT must first compare all the viable plans to one another. That means systematically looking at the similarities and differences among these plans. A useful comparison identifies differences among the plans that make a difference to people. It displays these differences and the trade-offs among them in a way that enables decision makers and others to see and understand those differences. That is where comparison stops; it does not say what is better or worse, only what is different. Selecting the TSP and recommending a plan are reserved for the Implementation task.

Comparison Steps

1. Identify a viable array of plans
2. Identify the comparison criteria
3. Assess differences for comparison criteria using without and with condition comparison
4. Find the differences among the comparison criteria effects for each plan
5. Compare the differences
6. Contrast the differences
7. Identify trade-offs
8. Display the differences with uncertainty
9. Explain the differences to people

A good comparison helps to separate the plans. It could make it clear that Plan A is better than Plan B. Comparison could enable the team to rate plans (good, better, best) or to rank them (first, second, third, and so on). At a minimum, comparing highlights the differences and trade-offs among the candidate plans. Comparing is critical for decision-making, and it may be done without rating or ranking plans.

There can be many plan features, both tangible and intangible, that need to be described so people can understand the differences among the plans. How long is the levee, where does it tie back into high ground, how high is it? What kinds of habitat are produced and for which species? That is description not comparison. Summaries describing the various aspects and attributes of a plan may incidentally include similarities and differences. That is not comparison either. Comparison is a purposeful and intentional act to say, *Hey, look over here, here are some things that are different (or the same) that you really need to know about.* Do not confuse comparison with description. Long systems of accounts and such are often more description than comparison.

Comparison begins with a viable array of plans (comparison step 1), the output of a completed evaluation process. If evaluation proceeds in a piecemeal fashion, some steps (1 – 3) of the comparison process can be initiated, but others (4 – 9) must wait until the entire evaluation process is complete. A set of comparison criteria must be identified (comparison step 2). These may or may not include an overlap with the evaluation criteria. Similarly, the decision criteria used to subsequently identify the TSP may or may not overlap with the comparison criteria. It is not an efficient use of resources to delve into a great deal of design and analytical detail for plans that may be eliminated from consideration by the evaluation process. However, once a viable array of plans has been identified, it is time to begin to systematically reduce some of the more significant uncertainty about critical plan effects. This is best done by first carefully identifying the comparison criteria, then analyzing them.

There are a lot of things that can be compared in a planning study and, quite frankly, no one cares about most of them. Will the side slopes, moisture content, or organic material content of a filter berm be important to people? Let us hope so. But let us also hope these things are only important to the people designing the filter berm. Few plans will be chosen because one has a filter berm with 30 percent moisture content by weight while another has 60 percent. Take care to compare important things.

Here are some logical candidates for things to compare:

- Plan effects
- Plan outputs
- Plan contributions to decision criteria
- Plan contributions to planning objectives and constraints
- Plan outcomes - will they solve problems and achieve opportunities?
- Physical features, location, and timing of plans are things to describe, as are many plan effects.

Comparison is important for at least two reasons:

1. To support decision-making, specifically providing the information needed to identify the TSP.
2. To inform and satisfy the public's varied interests in the plans.

Some criteria may persist throughout the evaluation, comparison, and selection processes. Others may wax and wane like the moon. It does not matter how it happens as long as all the important criteria are considered at some point in the Deciding task of planning. There will be *must have* criteria like costs and the BCR, which may have been used for previous screening iterations as well. There is also the set of criteria that will be used to identify the TSP. The decision criteria identified during scoping may include these criteria, if you are very good or very lucky; or, they may only emerge as the study progresses. In any event, these are important to include in the comparison of plans. If there are any planning objectives that have not yet been considered in the decision-making process, now is a good time to consider them. If there are mandates, legislative or otherwise, that require certain effects to be shown, do not forget them. Once the comparison criteria are identified, it is time for some more analysis.

To compare things, they must be measured in the same way. If the without and with condition differences in the comparison criteria have not been analyzed, it is time to do so now (comparison step 3), just as you did for the evaluation criteria. These evaluated effects of plans are the primary source of information for comparison and subsequent decision-making. Careful attention needs to be paid to the uncertainty attending these estimates, and quantitative or qualitative characterizations of significant uncertainty must be provided.

It may sound obvious, but someone must make an effort to recognize the differences among plans (comparison step 4) for the comparison criteria. This can be as simple a task as juxtaposing commensurate numerical values as is done in the example of Table 9.2. Simply putting facts together enables us to see they are different. Other comparison criteria may not lend themselves to such easy identification of differences. Differences in water quality impacts that involve multivariate measures of quality at different times and locations can be challenging to summarize. Differences must be searched for, found, and effectively displayed and documented.

Consider the benefit-cost ratio for three plans; three plans are used to keep the calculation of differences with uncertainty simple (uncertainty step 8). Figure 9.6 shows the relative uncertainty

of the three plans.[9] The delimiters show the probability that each plan will have a BCR less than 1 or more than 1.5. Likewise, they show the probability the BCR will fall between 1 and 1.5.

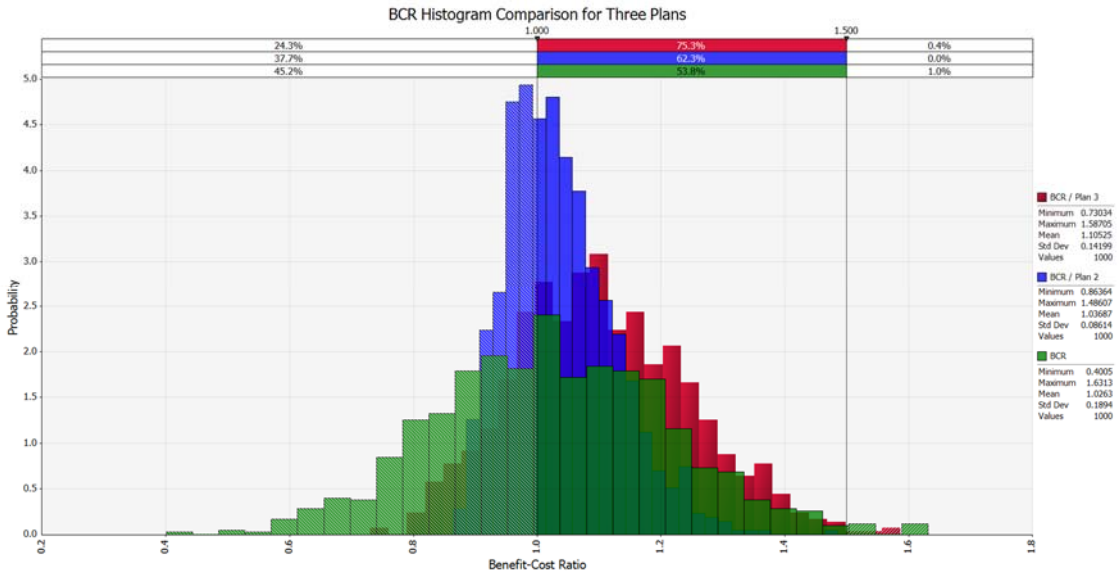

Figure 9.6: Comparison of benefit-cost ratio distributions for three hypothetical plans

Figure 9.7 provides the same information in an alternative cumulative distribution function view. The plan that lies furthest to the right is the preferred plan. Notice that for low outcomes the blue plan is best while the green plan is best for a narrow range of high outcomes. The red plan is best for the majority of all other outcomes.

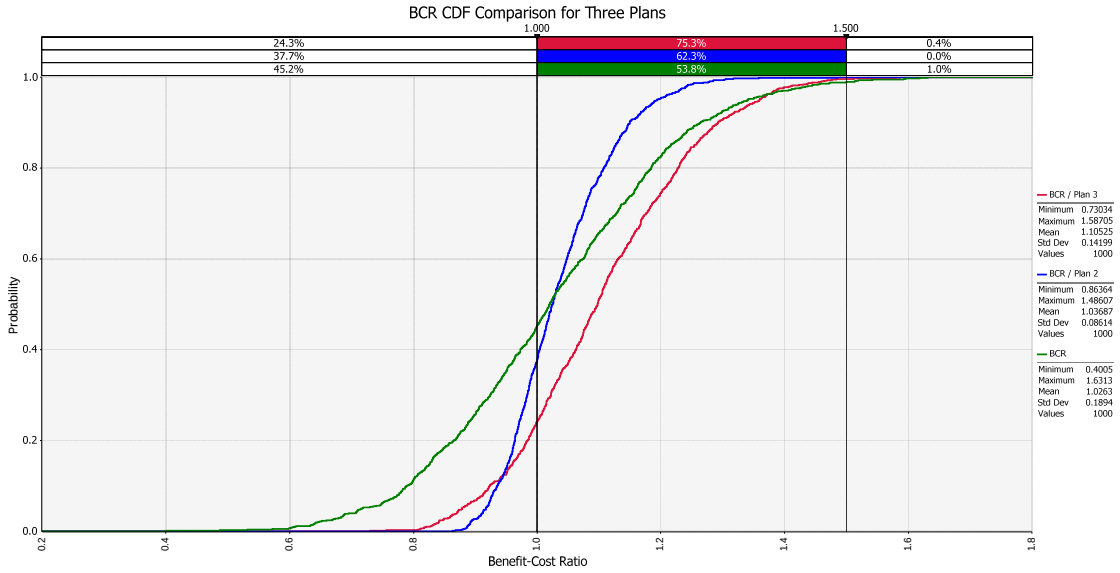

Figure 9.7: Comparison of benefit-cost ratio cumulative distribution functions for three hypothetical plans

[9] The green plan is the plan presented in Tables 8.1 and 8.2.

Table 9.3 shows the five number summary for each of the plans. Notice the differences. Once the differences in the criteria are calculated and identified, it is time to compare them (comparison step 5). That means identifying how they are alike (comparison step 6) and how they differ (comparison step 7). In what ways are the BCR differences alike? Look at the location and spread of distributions. Do they overlap? A little or a lot? Look at selected statistics, do they differ by much?

Table 9.3: Five number summary for three viable plans

Plan	Minimum	Q1	Median	Q3	Maximum
Green	.40	.90	1.02	1.16	1.63
Blue	.86	.97	1.02	1.09	1.48
Red	.73	1.00	1.10	1.20	1.58

In this example, the distributions overlap a great deal although some have higher peaks and others broader bases. All the plans have some likelihood of being inefficient, with a BCR less than one. The maximum values for the BCR are all rather close in magnitude. The median values of the green and blue plan are the same; the red plan median is a little bit better. There are no dramatic differences, but there are differences. The most intuitive aspect of comparison is to point out the differences.

The red plan has a 24.3 percent chance of being inefficient compared to a 37.7 percent chance for the red plan and a 45.2 percent chance for the green plan, advantage red plan. The blue plan has a higher and better downside, advantage blue plan. The green plan has a higher upside, advantage green plan. The red plan has a higher median, and its middle 50 percent of all values is higher than the other plans, advantage red plan. Decision makers will ultimately have to weigh these differences for themselves, but it would be normal for the PDT to form an opinion about which plan does best on this BCR criterion.

Ratios

Ratios can be a useful way to compare differences. Saying the Green Plan's minimum is half the Blue Plan's minimum may be easier to process than the raw numbers.

Narrative Comparison

Plan A is expected to prevent damage from a flood like the devastating flood of 2010 as well as any lesser flood. Plan B will prevent heavy thunderstorms from flooding low-lying roads in town, but it will do nothing to prevent damages from any of the four floods the town has had since 1970.

When looking for significant differences among criteria, differences in sign and orders of magnitude of effects can be important. There may be times when small differences in comparison criteria are significant. Numbers are numbers; they do not tell the same story to everyone. Telling a story about what the numbers mean and not worrying so much about what the numbers are (comparison step 9), can be an effective way to help people understand the differences among the effects of plans.

Here is an important caveat, be careful what you do measure and compare. We have been looking at the BCR. Figure 9.8 presents a comparison of the uncertain estimates of net benefits, an alternative measure of economic efficiency. Here we see much more dramatic differences than we saw with the BCR. The red plan has about a 1-in-4 chance of a negative return although it also has the potential for a negative return that is close to twice as large as the other plans might produce. On the plus

side, the red plan has a 1-in-4 chance of a return in excess of $10 million while the other plans have a less than 1 percent chance of such a return.

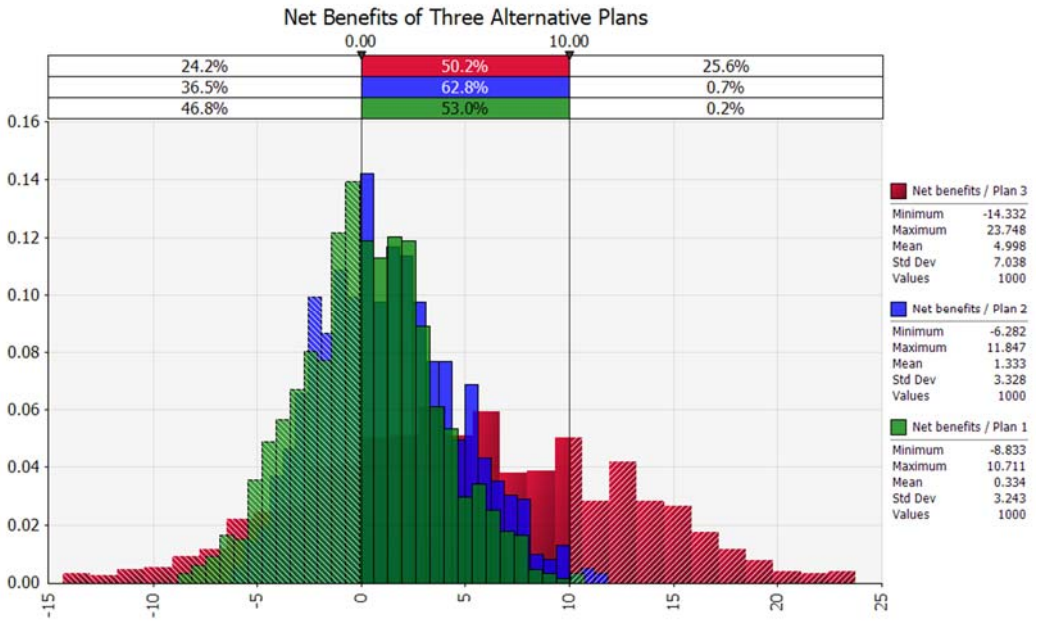

Figure 9.8: Comparison of net benefit distributions for three hypothetical plans

Until now, we have only considered a single criterion. It is rare for one plan to be better at everything. The usual case is for one plan to make more desirable contributions toward some comparison criteria and less desirable contributions toward others. When one plan gives more of some things you want, and less of other things you want than another plan does, you face a trade-off. With a trade-off, the only way to get more of one thing you want is to give up some of another thing you want.

Table 9.4 shows a sample comparison that illustrates trade-offs (comparison step 7). The red plan is better on the economic criteria of BCR and net benefits, but it does nothing for wetland acreage. If decision makers value net benefits and wetland acreage equally, the blue plan may provide a better bundle of outputs. If reductions in vulnerable population in the floodplain are also important, the green plan may look better

Table 9.4: Comparison of plan differences for selected decision criteria

Plan Comparison With Uncertainty			
	Blue Plan	Red Plan	Green Plan
Wetland Acreage	+74 to 81	No Change	+182 to 193
Expected Annual Damages Reduced Minimum	$38.1M	$38.6M	$7.1M
Q1	$40.3M	$47.7M	$14.8M
Median	$41.8M	$52.61M	$16.6M
Q3	$43.4M	$55.5M	$18.1M
Maximum	$49.1M	$62.3M	$24.4M
Houses Inundated	-20,449	-24,783	-23,765
Vulnerable Floodplain Pop. Minimum	55,000	96,004	96,004
Q1	60,617	101,363	101,363
Median	62,343	106,745	106,745

Plan Comparison With Uncertainty				
		Blue Plan	Red Plan	Green Plan
	Q3	68,450	112,144	112,144
	Maximum	71,3000	117,533	117,533
Net Benefits	Minimum	$-6.3M	$-14.3M	$-8.8M
	Q1	$-1.1M	$0.1M	$-1.8M
	Median	$1.1M	$4.7M	$0.3M
	Q3	$3.5M	$10.2M	$2.4M
	Maximum	$11.8M	$23.7M	$10.7M

The best way to begin to examine trade-offs is to look for dominating or dominated plans. Is there a plan that is best at everything? If so, it is a dominant plan. Is there a plan that is worse at everything? That would be a dominated plan. A dominant plan rises to the top while a dominated plan sinks to the bottom.

Identify the trade-offs that exist. Point out plans that maximize desirable contributions to the comparison criteria. Identifying plans that minimize desirable contributions can also help. Identifying differences makes comparison relatively easy. Making trade-offs makes it difficult. Explaining the differences and trade-offs to people, i.e., pointing them out, is an important contribution. It is important to display the uncertainty in decision criteria, as was done in the preceding discussion. The example of Table 9.4 is simplistic, but it is still difficult to see the trade-offs, especially when uncertainty is shown. In the messier real world, there are likely to be more criteria and far more, subtle trade-offs. That means the PDT explanation of the trade-offs and the uncertainty about them is critically important.

Formulation Hint

If you have a dominant solution, you may need another iteration of the formulation process because you offer no real choice in your array of final solutions.

Trade-offs can be made in an ad hoc fashion, or they may be made with formal decision analysis techniques. One such technique is multicriteria decision analysis (MCDA). This technique is discussed in some detail in Yoe (2002). Here a brief example using the information in Table 9.4 and Logical Decisions software will be used to demonstrate the technique. Figure 9.9 shows the basic model with four criteria.

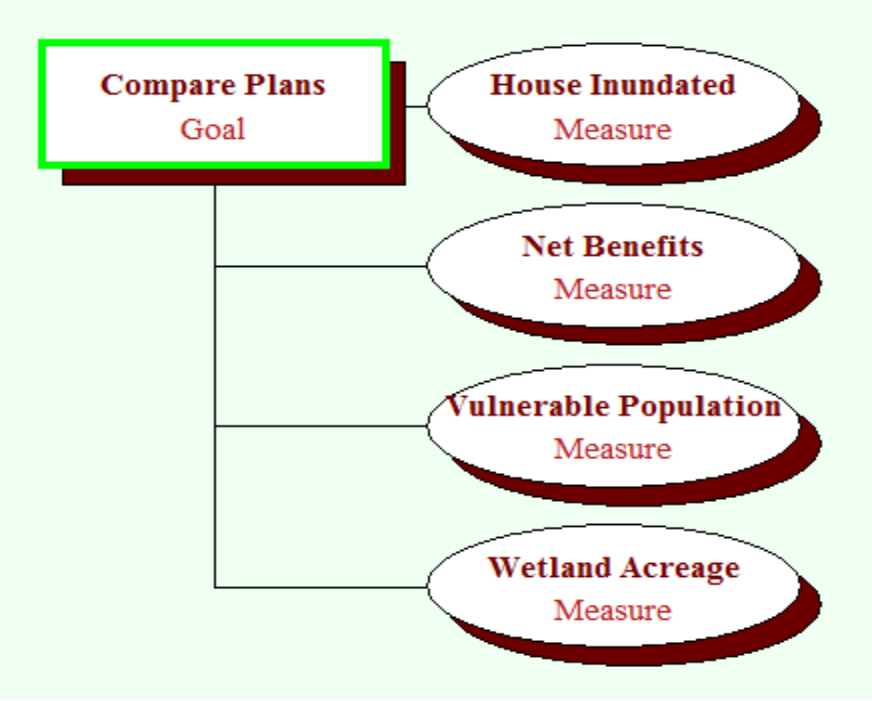

Figure 9.9: Multicriteria decision analysis model with one goal and four measures

Let the relative importance of these criteria be given by the weights in Figure 9.10.

	Least Preferred Level	Most Preferred Level	Scaling Constant (Weight)
Wetland Acreage Measure (new units)	0	193	0.35
House Inundated Measure (new units)	-20449	-24783	0.15
Vulnerable Population Measure (new units)	62343	106745	0.15
Net Benefits Measure (new units)	0.3	4.7	0.35

Figure 9.10: Criteria weights for the four criteria (measures) identified

Using these criteria, weights, and the available data with the MCDA algorithm, a comparison of the plans can be generated as shown in Figure 9.11. Plan green is shown to be the one that performs best given the criteria and their subjective weights. MCDA is a useful tool for comparing the overall effectiveness of plans for a given set of criteria weights. Because these weights cannot be objectively determined, USACE has not looked favorably on MCDA as a decision-making tool. It is, however, useful for illustrating trade-offs.

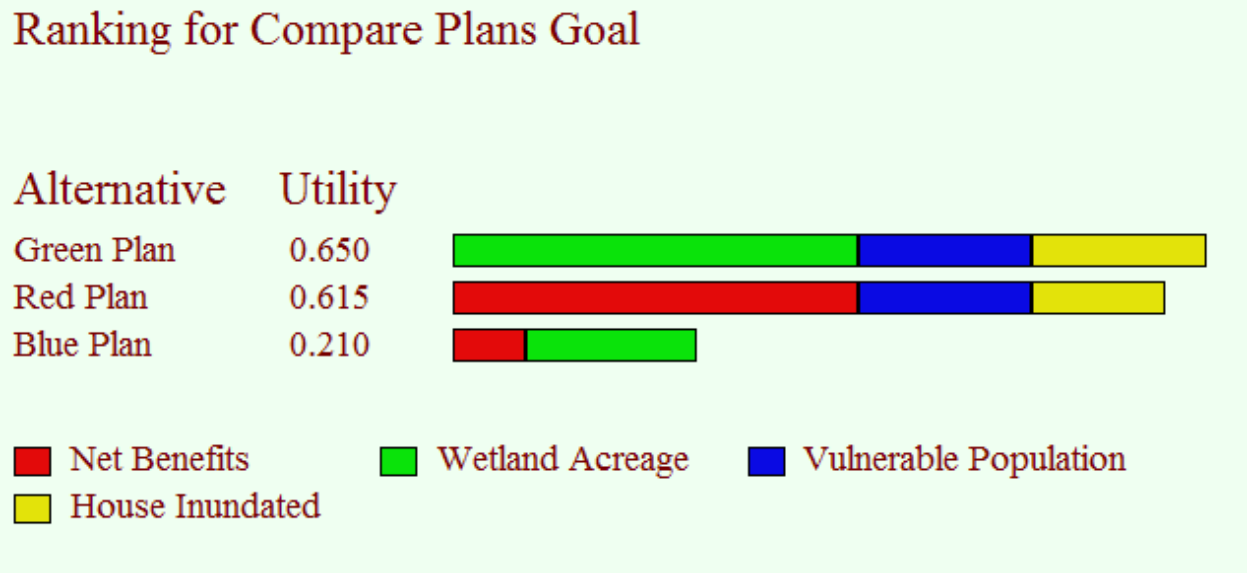

Figure 9.11: Plan scores derived from a MCDA process

The color-coded bars that comprise the scores indicate the relative strengths and weaknesses of the plans relative to each other. The green plan, for example, is best for wetland acreage, and it is strong on inundated houses protected and in removing vulnerable population from the floodplain. It is the worst plan for net benefits, however, as the absence of a red bar indicates. Likewise, we can quickly see the red plan is weakest on wetland acreage. The blue plan is weak on removing inundated houses and vulnerable population from the floodplain. The trade-offs are relatively easy to see, but they are contingent on the subjective weights chosen.

It is quite easy to explore the sensitivity of the ranking to the size of the subjective weights as seen in Figure 9.12. Here the relative importance of net benefits is increased as the importance of wetland acreage is decreased and net benefits increases. Notice how much superior the red plan becomes as the weights are varied.

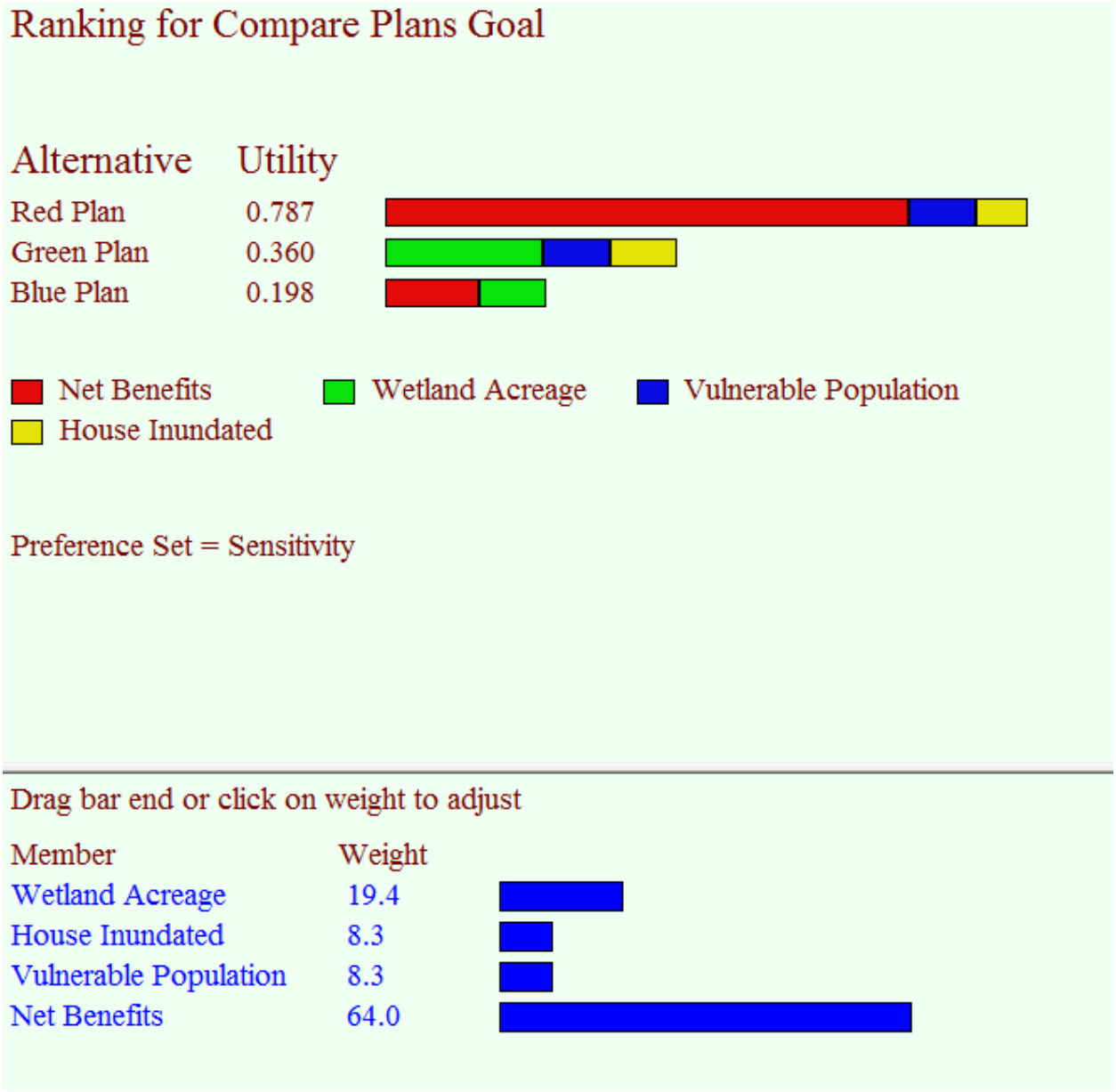

Figure 9.12: Plan score sensitivity can be explored by changing criteria weights

A good comparison explains the meaning of the differences (comparison step 9) to decision makers. The comparison summary does not have to be complex. It could be as simple as an expanded version of Table 9.3. Its purpose is to extract the important details from all of the evidence gathered and distill it for the interested reader and the decision maker while managing to convey a sense of the uncertainty that remains. What makes this task truly challenging is representing the uncertainty associated with the assessed effects in the display of the information. This is an art in its infancy in planning. In almost every instance, you will not know the true values of the numbers you attempt to display in your comparison. So admit it, and help the reader by letting him/her know how unsure you are.

9.6 Five Points to Take Away

Here are five key points to take away from this chapter.

1. The deciding stage of planning comprises verifying that mixes of measures are ready to be considered plans, evaluating plans to identify those that are viable TSP candidates, and comparing plans so that the choices of the TSP are as easy to make as possible.
2. A combination of measures becomes a plan when they are complete, effective, efficient, and acceptable.
3. Criteria describe the performance of the plans and their contributions to the planning objectives.
4. Evaluation, comparison, and selection criteria may overlap, be distinctly different sets with no common criteria, or may use identical criteria.
5. Displaying and explaining the importance of uncertainty may be the PDT's greatest challenge in the deciding stage.

9.7 References

Yoe, Charles. (2002). *Trade-Off Analysis Planning and Procedures Guidebook.* Alexandria: Institute for Water Resources.

Yoe, Charles. (2012). *Guide to Constructing the Without Project Scenario (Condition)*. Alexandria; Institute for Water Resources.

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Chapter 10
Task Four—Implementation

"And will you succeed? Yes indeed, yes indeed! Ninety-eight and three-quarters percent guaranteed!" — Dr. Seuss — Dr. Seuss, Oh, The Places You'll Go!

10.1 Introduction

Implementation is the transitional stage of the planning process. It moves a project from its birth in the planning process into its life cycle as a project. Implementation includes step 6 of the P&G planning process, and it consists of decision-making and analysis. It begins when the Deciding task is completed, or, if you prefer, it completes the deciding process. There are four principal planning activities in the implementation stage of planning; they are shown in Figure 10.1. The first two tasks, determining a tolerable level of risk for the community and identifying the TSP, are closely intertwined. Some analysis may follow this decision if the scale and other attributes of the TSP need to be optimized.

The TSP is subjected to at least a qualitative risk assessment to identify any significant risks that could result from its implementation. The optimized and risk assessed TSP and the reasons for its choice must be vetted through the relevant channels of higher authority where it becomes a plan recommended by USACE. At that point, the plan is ready to move forward into PED stage of its life cycle. As it does, the risk history of this plan, which comprises the planning phase RR and the TSP risk assessment, moves forward with it to inform risk managers in the next stage of the project's life cycle.

Who Decides

The VT identifies the TSP. Following review, a recommended plan is selected. At the present time, the selected plan that appears in the Chief's Report is still considered a recommendation. Both the Assistant Secretary of the Army for Civil Works and the Congress can be considered decision makers.

Developing these four planning activities is the primary purpose of this chapter. This discussion of Implementation begins by returning to two important concepts, the tolerable level of risk (TLR) and residual risk.

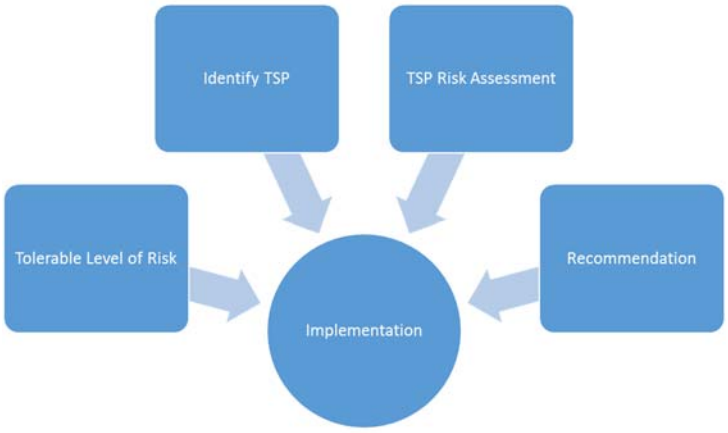


Figure 10.1: Principal planning tasks in the implementation stage

10.2 TLR and Residual Risk

It is time to make a decision. The goal of the *decision* step is to decide the best action to take to meet planning objectives and avoid constraints, thereby solving the problems and realizing the opportunities identified during scoping. There is another important thing going on in this step, however, this is when the PDT effectively determines the tolerable level of risk for every risk addressed in the planning investigation. That needs to be a very intentional consideration in the team's TSP identification because it determines the residual risk a community will be left to face.

Let us review a little terminology. An acceptable risk is one with a probability of occurrence so small, consequences so slight or perceived or real benefits so great, that individuals or groups in society are willing to take the risk or be subjected to the risk that the event might occur. Acceptability is a matter of subjective judgment; it is not a scientific determination. A risk that is judged acceptable requires no risk management. A risk that is not acceptable is, by definition, unacceptable and must be managed. It is conceptually possible to reduce an unacceptable level of risk to an acceptable level; however, more often than not, unacceptable risks are managed to tolerable levels.

A tolerable risk is not an acceptable risk. It is an unacceptable risk whose severity has been reduced to a point where it is tolerated. Such a risk is tolerated for one of three general reasons: it may be impossible to reduce the risk further, the costs of additional risk reduction are considered excessive, or the magnitude of the benefits associated with the risky activity are too great to reduce the risk further. The tolerable level of risk is a subjectively determined level of risk that marks the compromise point between an unacceptable risk and an acceptable risk.

When the VT recommends a plan, they establish the TLR and the residual risk. Residual risk is the risk that remains after risk management options, i.e., plans, have been implemented. The TLR is determined explicitly or implicitly by the PDT. In the first instance, a specific TLR is established as a goal, and the PDT formulates plans to try to achieve this goal. In the second instance, the TLR is what results when the VT recommends a plan at the end of the planning process.

A VT chooses a TLR explicitly if, for example, they establish a flood risk management goal of reduced damages from a flood with a 0.2 percent exceedance frequency and then formulate plans to achieve it. They choose implicitly if they choose the NED plan, which happens to reduce damages from a 0.8 percent exceedance frequency flood. If Congress directs the USACE to prevent the spread of aquatic nuisance species, that is an explicit determination of a TLR. If the USACE implements a series of ANS control measures, the resulting probability of spread is an implicit determination.

The most essential part of establishing a TLR for a community, whether explicitly or implicitly, is assessing and understanding the residual risk. Thus, for example, if a community has protection, say, from a 0.2 percent exceedance frequency flood, it is going to be important to know exactly what that means to the community in terms of residual risks. Conveying this kind of information is going to require the development and use of risk metrics, i.e., a variety of measurements that fully characterize the relevant risk dimensions of a decision.

Some examples of risk metrics include such things as:

- **Life safety risk**
  - Number of fatalities

- Social vulnerability

- **Economic risk**
  - Net economic benefits
  - Financial risks
- **Engineering risk and reliability**
  - Probability of failure
  - Fragility curves
  - Redundancy
- **New metrics**
  - LSAC I to IV
  - DSAC I to IV
  - Partitioned risk

In addition, and importantly, probabilistic estimates of any uncertain value comprise risk metrics. Thus, probabilistic estimates of benefits and costs, as well as other well-known plan effects, become risk metrics. This is going to present a challenge to the VT and decision makers because it is a new way of presenting information. Consider the example of a decision metric like the BCR. The BCR is no longer 1.02; planning work was never that precise. Instead, such a risk metric can be reported as a five number summary:

Minimum =0.4, 1st quartile = .09, median = 1.02, 3rd quartile = 1.16, maximum = 1.63

The box and whisker in Figure 10.2 or a histogram like that of Figure 10.3 are alternative ways to show the data.

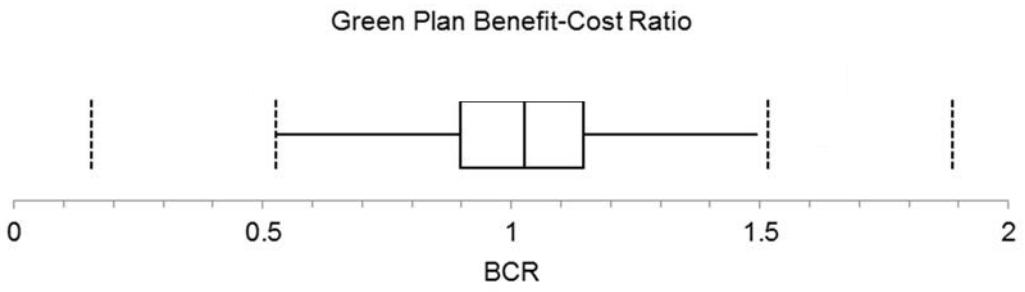


Figure 10.2: Box and whisker plot with five number summary for BCR of a hypothetical project

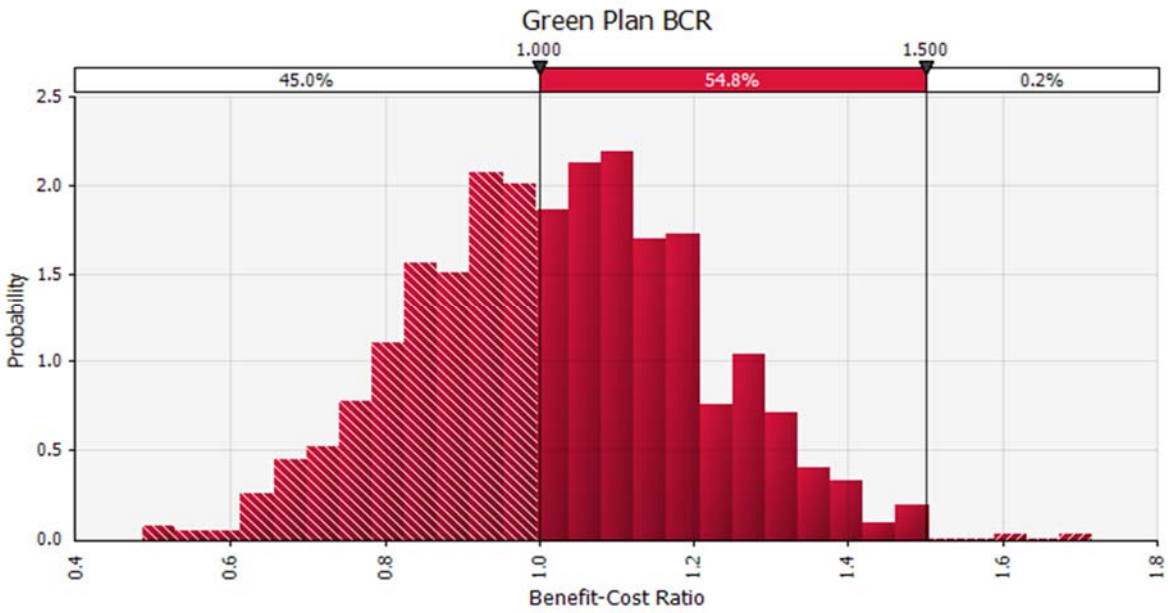


Figure 10.3: Histogram of BCR values for a hypothetical project

The *green plan* from Chapter 9 has been carried forward. One can see from these figures that the probability this project will not yield a positive return, i.e., the BCR < 1, is about 45 percent. There is a 0.2 percent chance the project's BCR will exceed 1.5. Thus, the risk that this project will not produce net gains is significant. The uncertainty about the net benefits is significant. Is that a tolerable level of risk? This uncertainty does not afford a high degree of confidence in the outcome. Efforts to further reduce uncertainty and produce a more reliable estimate of the BCR may be warranted before a recommendation is made. On the other hand, a 55 percent chance of an economically efficient project may be sufficient reason to move forward with this plan. In the first example, the risk is seen as unacceptable; in the second, it is considered tolerable. That determination is a subjective one that would be made first by the vertical team and later confirmed, modified, or rejected by higher authority decision makers.

In order to determine a tolerable level of risk, it is important to understand the residual risk, i.e., the risk that will remain when the plan is implemented. Residual risk can be defined in many ways, including the residual risk of a BCR < 1. Expected annual damages have, for a long time, been a principal means of expressing the residual risk to the affected community. Figure 10.4 shows three levels of risk as measured by uncertain expected annual damages. Existing EAD on the far right show the uncertainty about the existing flood risk. EAD remaining after the plan is implemented comprise the residual risk shown by the blue distribution on the far left. The potential risk reductions are shown by the green distribution in the center of the graph. It should be clear from the distribution of residual risk that flood risks are not eliminated. This plan simply provides a more desirable level of flooding as far as the EAD measure is concerned. It transforms the community's flood risk from the far right distribution to the far left distribution. There is uncertainty in both of these positions.

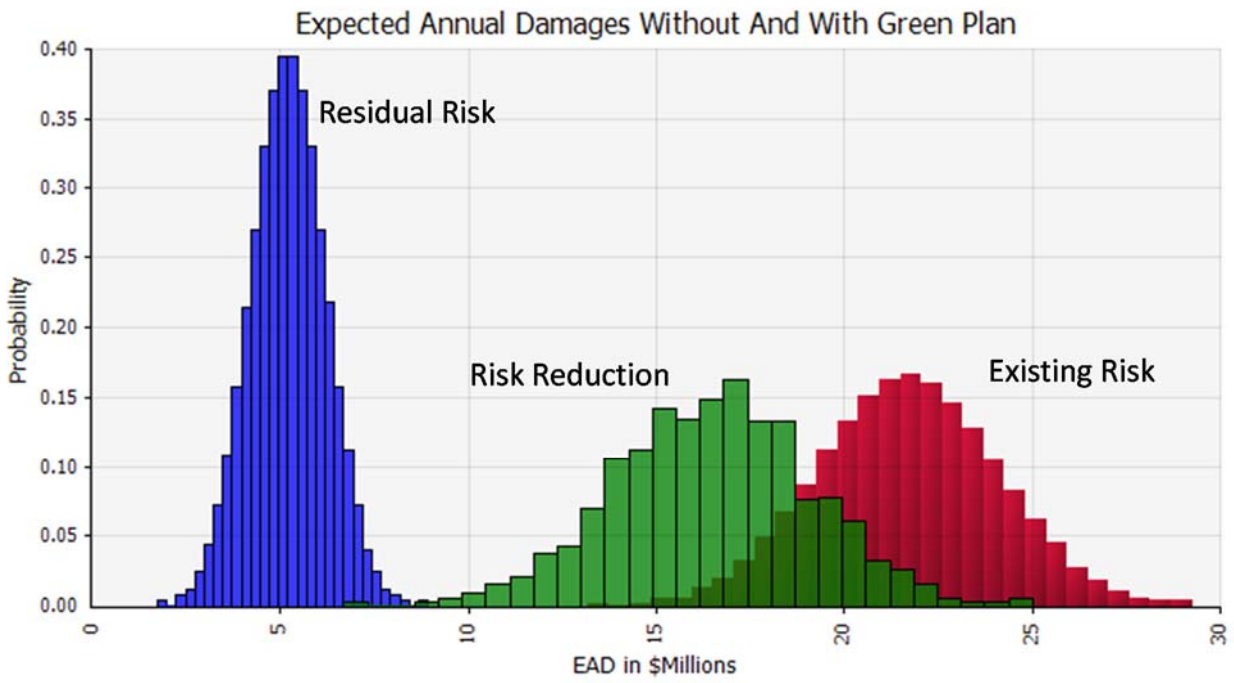


Figure 10.4: Distributions showing uncertainty about existing risk, risk reductions, and residual risk

The residual risk warrants a closer examination. A boxplot is shown in Figure 10.5, and a numerical description of the uncertainty is shown in Table 10.1. EAD is not a well understood risk metric outside USACE. Probabilistic measures of risk are inherently difficult for the public to understand.

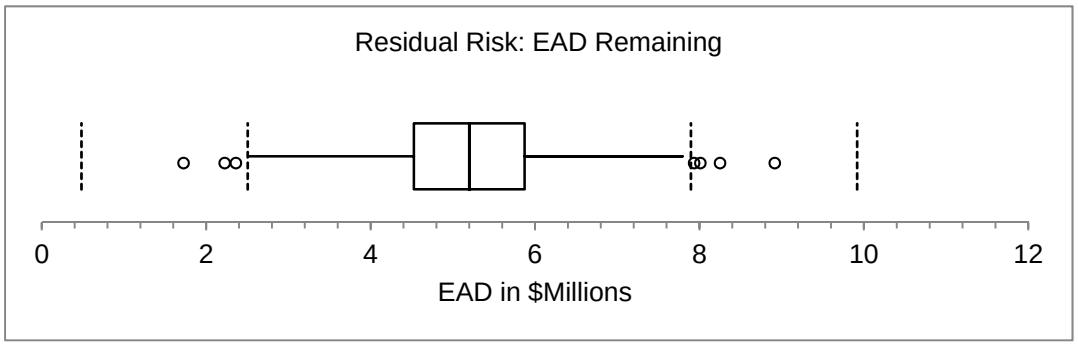


Figure 10.5: Box and whisker plot of residual risk measured as expected annual dollar damages remaining after the plan is implemented

Table 10.1 Five number summary of residual risk measured as millions of expected annual dollar damages for the green plan

	Minimum	Q1	Median	Q3	Maximum
EAD in $Millions	$1.7	$4.5	$5.2	$5.8	$8.9

In a community that sustained over $1 billion in damages, residual damages of $8.9 million sound trivial. Unfortunately, the public may not realize this value is so low because it takes a flood with an exceedance frequency of 0.2 percent to cause a flood. If such a flood occurred, damages would be in excess of $1.2 billion; therefore, stakeholders need a better perspective on the residual risk than EAD provides. One such measure would be the estimated damages from a flood that would exceed the capacity of the flood risk management system, the $1.2 billion in this case. Another option is to estimate the conditional expected annual damages using a risk partition.[10] This method takes the damages associated with the frequency of flows that exceed the capacity of the flood risk management measures and it normalizes that portion of the damage frequency curve. This is a new risk metric that in effect says, given that a flood that exceeds the capacity of the flood risk management measures occurs, its expected annual value is $1.31 billion. This metric enables planners to say that even though flooding will be rare, if a flood occurs, it will have an average of $1.31 billion dollars in damages. With protection from a 0.2 percent annual chance exceedance (500 year) flood, there is still about a 14 percent chance a resident who lives in this floodplain for a 75-year lifetime will be flooded at least once.

It would be equally important to describe the residual risk metrics for life risk, vulnerable populations, and other appropriate decision metrics. Flood risk metrics are more developed than risk metrics for other project purposes. There is a great need for planners to develop useful measures of risk for the wide variety of project purposes and the even wider range of planning objectives. It is essential to provide stakeholders with descriptions of residual risk that are meaningful. The PDT is implicitly choosing a TLR for the community when they recommend a plan. It is essential that they characterize the relevant residual risks for the plan as part of their decision-making process. The residual risk becomes the level of risk that must be tolerated in the study area for the recommended NED plan.

10.3 The TSP

A great many planners would be surprised to learn that under NEPA regulations (40 CFR 1502.14(d)), *No Action*, is the default recommendation. Deciding whether doing something is better than doing nothing is, therefore, the first significant implementation decision the VT must make. That decision is usually made well before the Formulation and Deciding tasks are completed; it happens when the VT establishes the existence of a Federal Interest. Failing to establish a Federal Interest in a planning study essentially means accepting the No Action alternative. Finding a Federal Interest tends to mean rejecting the *No Action* alternative. Thus, the first iteration in identifying the TSP occurs far earlier in a study than most people would suspect. This initial decision is confirmed or amended as the study moves into the Implementation stage.

It is possible that despite an early finding of a Federal Interest, more detailed analysis may show otherwise, resulting in a reversal to recommend No Action.

10 The details of this calculation are a bit too complex for this manual. The additional numeric values cannot be derived from data presented. They are details derived form an example outside the manual. Consider this as an example of the new kinds of risk metrics that could be used to help stakeholders understand the residual risk.

Once the VT has committed to rejecting the No Action alternative, they must decide which one of the alternative plans in the final array to recommend. The second default decision since the P&G were implemented has been to select the NED plan.

There are four basic ways of decision-making that are used in planning. Figure 10.6 summarizes them. First, the methods are separated into formal and informal decision theory methods. Next, decision makers can consider all or just some of the decision criteria. These two decision-making dimensions create the four quadrants in the figure.

Formal methods that explicitly consider all of the decision criteria, like MCDA methods, have been applied in USACE decision-making although the subjective nature of the criteria weights makes some USACE decision makers uncomfortable with this method. It has been more common to observe formal methods that use a subset of the decision criteria, like the NED plan policy, that results in teams choosing the plan that maximizes net NED benefits.

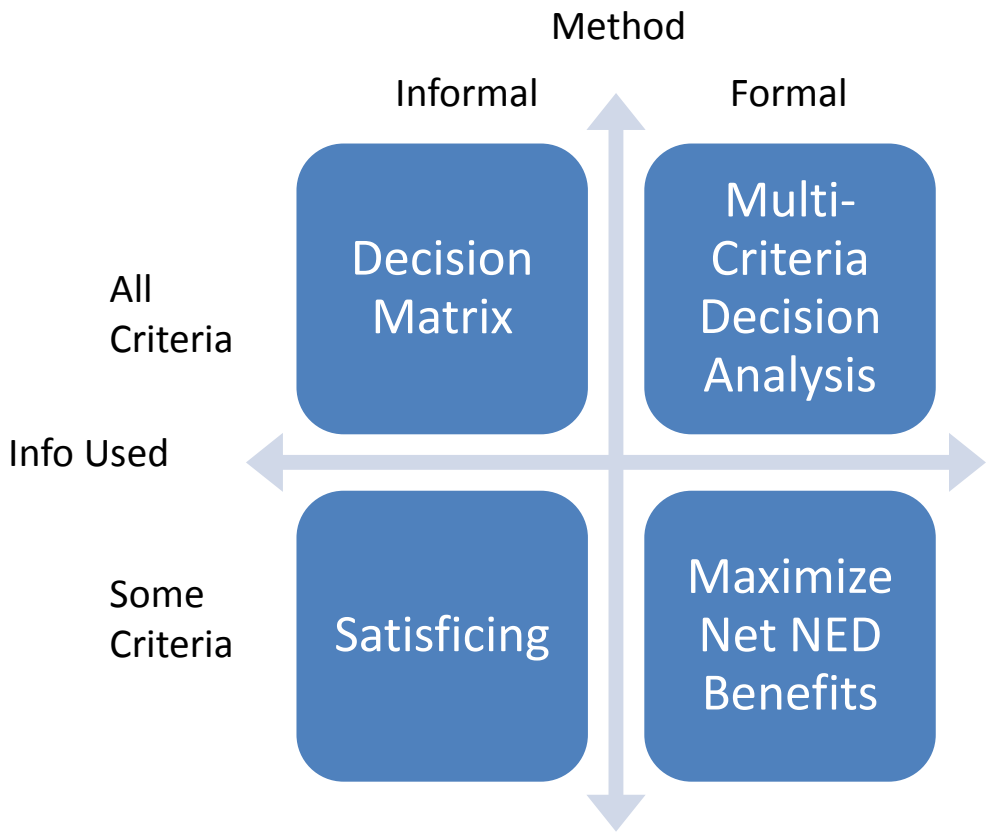


Figure 10.6: Four basic decision-making techniques planners can use

Informal methods that use a subset of the decision criteria are satisficing methods that seek to assure a plan is *good enough* based on the subset of criteria favored by the decision makers. This method is not known to be used by USACE. The remaining method relies on the use of a decision matrix (see Figure 10.7 for an example) that displays all of the decision criteria. The PDT then considers all of the data in an often ad hoc manner to arrive at a decision. For most decision-making, one or a few criteria will emerge as most important to decision makers.

Table ES.1 GLMRIS Evaluation Criteria Summary

		GLMRIS Alternatives Evaluation Criteria†												
				Effects of GLMRIS Alternatives										
		Effectiveness at Preventing Interbasin Transfer (at time of implementation)	Implementation (years)	Negative CAWS Environmental Impacts	Negative Water Quality Impacts (CAWS)	Negative Water Quality Impacts (Lake Michigan)	Water Quality Mitigation Measures Cost[4]	FRM (net change in EEAD – an annual impact)	FRM Mitigation Measures Cost[4]	Commercial Cargo Cost Impacts (annual cost)	Non-Cargo Navigation Impacts	Complexity of Regulatory Compliance	Cost of the ANS Control and Mitigation Measures[4]	Nonstructural & OMRR&R Costs (annual)[4]
GLMRIS Alternatives	No New Federal Action – Sustained Activities	★	The No New Federal Action – Sustained Activities Alternative assumes that any currently funded ANS prevention actions are maintained to include the operation of the existing electric barrier in Romeoville, IL. All alternatives below are actions in addition to the No New Federal Action – Sustained Activities Alternative. For complete details on this alternative, please review Section 3.8.											
	Nonstructural Control Technologies	★★	0	L	L	L	N/A	$0	N/A	Likely minimal[3]	L	L	$–[5]	$68 M
	Mid-System Control Technologies without a Buffer Zone – Flow Bypass[2]	★★★	25	M	L	L	N/A	$1.1 M	$9,100 M	$0.75 M	L	M	$15,500 M	$210 M
	Technology Alternative with a Buffer Zone[2]	★★★	10	H	L	L	$1,600 M	$0.6 M	$2,000 M	$0.50 M	M	M	$7,800 M	$220 M
	Lakefront Hydrologic Separation[2]	★★★★	25	H	M	Improves[1]	$500 M	$66.0 M	$14,500 M	$210 M	H	H	$18,300 M	$160 M
	Mid-System Hydrologic Separation[2]	★★★★	25	L	H	H	$12,900 M	$1.1 M	$24 M	$250 M	M	H	$15,500 M	$140 M
	Hybrid – Mid-System Separation Cal-Sag Open[2]	★★★	25	H	M	M	$8,300 M	$28.1 M	$1,900 M	$7.30 M	M	H	$15,100 M	$180 M
	Hybrid – Mid-System Separation CSSC Open[2]	★★★	25	M	H	M	$4,300 M	($26.4 M)	$145 M	$8.80 M	M	H	$8,300 M	$160 M

† Evaluation Criteria Descriptions are located on the reverse side of this table.

[1] Under the Lakefront Hydrologic Separation Alternative, stormwater and CSOs would no longer be able to backflow to Lake Michigan, likely reducing beach closures and contaminant loading to Lake Michigan.

[2] This alternative includes the nonstructural measures identified in the Nonstructural Alternative.

[3] A quantified evaluation of the impacts of the Nonstructural Alternative was unable to be completed. Based on professional judgment, the impacts are believed to be likely minimal.

[4] The costs presented in the GLMRIS Report are commensurate with the five percent level of detail in design for each alternative. The cost and schedule estimates are appropriately used in this report as a means to compare the alternatives presented. The funding stream for an alternative is assumed to be sufficient to support annual progress to meet corresponding implementation timelines. These cost and schedule estimates are not intended to support authorizing language, and will change with more detailed designs of an alternative.

[5] Estimated initial costs for the Nonstructural Alternative are assumed negligible and sufficiently captured by the estimate for the annual OMRR&R Costs.

Figure 10.7: Example of a decision matrix from GLMRIS Report 1/6/2015

Let us revisit the relationship among decision and selection criteria shown in Figure 10.8, a simplified version of Figure 9.4. Plan effects are the broadest and most encompassing category of measurements of the impact of a plan. Some of these plan effects will have been identified during scoping as decision criteria; others may be identified in subsequent DMPs as the decision criteria to use to identify the best plan. In fact, the decision may be made based on a subset of the decision criteria, here called the selection criteria. For example, there are 13 decision criteria shown in Figure 10.7. Hypothetically, a decision could be based on a subset of them, say the effectiveness of preventing inter-basin transfer, implementation years, and cost of the ANS control and mitigation. If a plan is chosen solely on the basis of net NED benefits, there is only one selection criterion no matter how many decision criteria may exist.

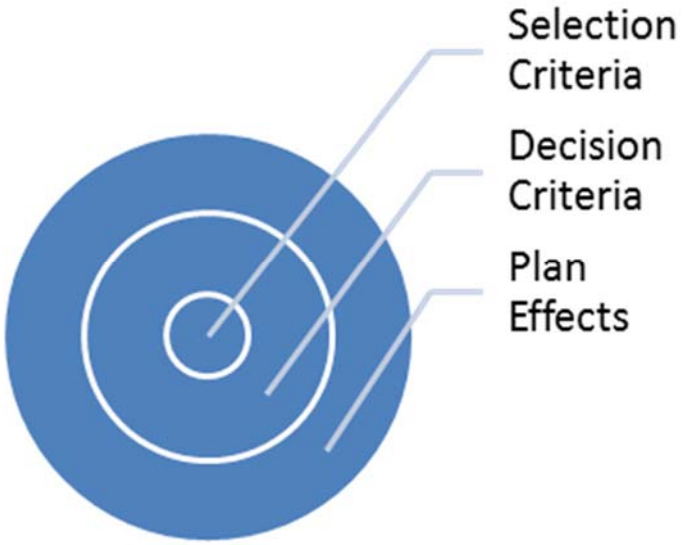


Figure 10.8: The relationship of selection criteria to decision criteria and plan effects

A goal of risk-informed planning is to assure that all the decision criteria are considered in decision-making. This assures that important truths are considered and that decision-making is more transparent. This can be done by using a formal decision process that can encompass more criteria, like MCDA, or it can be done by reducing the set of decision criteria to what is actually used to make decisions. Figure 10.9 illustrates this simple goal. All it requires is transparency about the criteria that will be used to make decisions, a process that is greatly enhanced by the use of the decision management plan, which requires the vertical team to agree on both the specific criteria and the metrics for those criteria that will be used for making the selection decision.

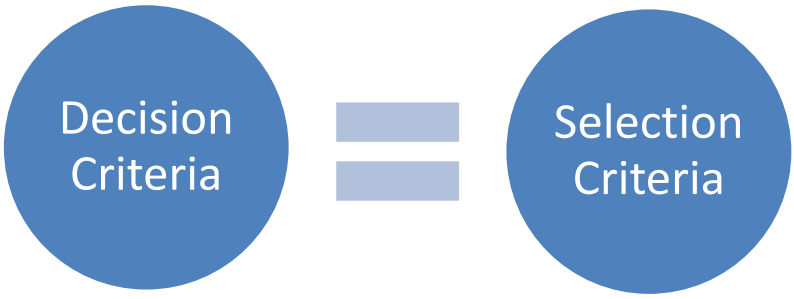


Figure 10.9: A condition for transparent decision-making

Assuming a Federal Interest is found, both formal and informal decision-making methods at this stage require:

1. Decision criteria
2. A decision matrix
3. Subjective weights for the criteria
4. Apply decision algorithm if one is used
5. Consider the uncertainty
6. Order the alternatives
7. Choose the TSP
8. Document basis for decision

The decision-making methods are usually distinguished by the extent to which steps 3 through 7 are structured and differentiated from one another. They can also be distinguished by the decision-making style used by the VT.

- Decisive decision makers consider a limited amount of information. They are usually interested in a good (not necessarily the best) solution and often rely on their personal experience and gut feel for a situation.
- Flexible decision makers also tend to use limited information, but they use a more collaborative decision-making style. They are also more willing to change their decision based on new information.
- Hierarchical decision makers rely on a maximization process. They tend to focus narrowly on the decision criteria, and some criteria are more important than others. This tends to describe the traditional USACE decision style.

- Integrative decision makers consider the data broadly and in a collaborative style. All the decision criteria are used to select the best solution from among an array of viable solutions.

The actual decision process may remain implicit with decision makers (called an informal process here), or it can be made explicit (called a formal process) through more structured and transparent decision processes.

If you are very, very good or very, very lucky, the decision criteria will be exactly those identified during Scoping (decision-making step 1 above). It is more likely that list will have changed a few times before the final decision matrix is prepared. If decision criteria were identified early in the planning process, they should be confirmed as still relevant selection criteria. If the criteria have changed or if decision makers will decide, based on different information, the criteria need to be amended, and that information should be conveyed to interested stakeholders.

The decision matrix (decision-making step 2) organizes and displays the relevant values for the decision criteria and the final array of alternative plans. Ideally, the matrix entries should characterize the relevant uncertainty in its criteria values (decision-making step 5) and avoid using point estimates for uncertain values. Cleary, this will be a challenge for a matrix with 13 different criteria, for example. When the selection criteria are a relatively small subset of the original decision criteria, however, this is a more reasonable goal. The decision matrix is to provide a succinct and transparent summary of the information decision makers will need to choose a best plan. Table 10.2 repeats data first seen in the last chapter, assume these are the four criteria that will be used to choose the TSP.

Table 10.2: Hypothetical decision matrix with uncertain values displayed (all $ values in millions)

Plan Comparison With Uncertainty				
		Blue Plan	Red Plan	Green Plan
Wetland Acreage		+74 to 81	No Change	+182 to 193
Houses Inundated		-20,449	-24,783	-23,765
Vulnerable Floodplain Pop.	Minimum	55,000	96,004	96,004
	Q1	60,617	101,363	101,363
	Median	62,343	106,745	106,745
	Q3	68,450	112,144	112,144
	Maximum	71,3000	117,533	117,533
Net Benefits	Minimum	$-6.3M	$-14.3M	$-8.8M
	Q1	$-1.1M	$0.1M	$-1.8M
	Median	$1.1M	$4.7M	$0.3M
	Q3	$3.5M	$10.2M	$2.4M
	Maximum	$11.8M	$23.7M	$10.7M

In formal methodologies, like MCDA, decision makers must say which criterion is most important and often by how much. For example, imagine there is 1 point of weight to spread over the four criteria. One possible explicit weighting scheme (decision-making step 3), seen earlier, is:

Table 10.3: A set of criteria weights

Criteria	Weight
Wetland Acreage	.35
Houses Inundated	.15
Vulnerable Floodplain Population	.15
Net Benefits	.35

Informal methods are not likely to assign explicit weights to criteria. If they do make weights explicit, they are likely to be non-numerical expressions of the relative importance of the criteria. Formal methods usually include a mathematical algorithm (decision-making criterion 4) to render the different measurements of the criteria commensurate in some way and to apply the weights to these measurements in order to produce a single index number that represents the overall utility or value of a plan. When a numerical measure is produced, the alternatives are easily ranked (decision-making criterion 6) from least to most desirable, based on the algorithm. The more sophisticated algorithms include sensitivity analyses that enable analysts to examine the effect of changes in subjective weights and the impact of variation in the decision criteria themselves. All of this culminates in an identification of the best plan (decision-making criterion 7) under conditions of uncertainty. MCDA methods, reviewed earlier in the manual, provide the best examples of such formal methods; see Yoe (2002) for more details.

Uncertainty Rating Terms

Decision-making might be aided by appending uncertainty ratings (think the flip of confidence ratings) to decision criteria and other important study results. Two sets of examples follow.

High - there is little to no concrete evidence available.

Medium - there are some good evidence and some significant data gaps.

Low - good evidence is available; data gaps are not significant.

None - all relevant facts are known.

An alternative set of definitions is found below.

High - there is a very broad range of possible outcomes that include extremes.

Medium - extreme outcomes are not possible.

Low - there is a limited range of possible outcomes.

None - all relevant facts are known.

In the more common informal methods, all of these steps, from weighting through identification of the best plan, are combined in imprecise and difficult-to-describe ways to produce a decision. Criteria importance may be expressed ordinarily, or it may be left implicit. The deciding individual(s) may use an inexact calculus to combine the more objective decision matrix information with the more subjective importance weightings to produce a full or partial ranking of the alternatives. The team might look at Table 10.2 and decide Plan Red is best because it looks better on most criteria. Alternatively, if wetlands acreage is more important, Plan Green may be recommended. This is the messy nature of decision-making. No matter how this recommendation

is reached, it is incumbent upon the PDT to explain the basis for their decision in a carefully documented manner (decision-making step 8). The output of this work is the PDT and vertical team identification of a TSP. At the current time, it is common practice for USACE planners to identify the NED or a combined National Economic Development/National Ecosystem Restoration (NED/NER) plan as the TSP.

One of the most useful and rare things found in a planning study is a simple paragraph that says, "The selection criteria used to select the plan recommended for implementation are…" The reason it rarely appears is even after all the work that was done, the team either does not know how the plan was selected or it has simply failed to convey that information. The simplest way to improve the transparency of the decision process is to identify the selection criteria that were actually used.

10.4 TSP Risk Assessment

Following their choice of a TSP, the PDT should conduct at least a qualitative risk assessment of this plan in order to identify the residual risk that remains with the plan, if they were not included among the decision criteria, and to identify any new, transformed, or transferred risks generated by the new plan. A risk assessment of a flood risk management plan for example would include consideration of the risk of levee failure or overtopping, increases in the number of lives and property at risk attributable to the project, induced flooding, and induced levels of economic activity in the protected areas in addition to characterizing the residual risks that remain. A NER plan could change the quantity, quality, timing, and presence of water in ways that could introduce significant new ecological risks that must be considered and assessed. Using an electronic barrier to prevent the passage of aquatic nuisance species could impede the flow of indigenous species, present a safety risk to anyone in or near the barrier, or damage sensitive technology on adjacent boats.

A new plan could introduce both new hazards and new opportunities to a project area. No plan should be implemented until these new or transformed hazards and their associated risks can be assessed and communicated to decision makers and the public. This risk assessment activity is restricted to the TSP.

Once the selected plan is verified by Congress, the project life cycle of the plan is extended. The final step in this implementation stage of the planning process is for planners to provide the risk history of the selected plan to the PED risk managers. This will include the RR prepared during the study as well as the TSP risk assessment. These materials will provide the PED risk managers with a solid foundation for understanding the past and future risks associated with the project.

10.5 The Recommended Plan

The ultimate decision makers in the planning process are:

- The Chief of Engineers
- The Assistant Secretary of the Army for Civil Works
- Congress
- The President

Clearly this is a high visibility set of decision makers.

The VT usually identifies a plan, the TSP, which becomes the Recommended Plan after USACE endorses the plan. The Chief of Engineers concurs with or modifies the TSP, and it becomes the selected plan of the Chief's Report, which contains the official recommendation of USACE. At the time of this writing, the actual decision to implement this plan or to take some other course of action belongs to the Assistant Secretary of the Army for Civil Works (ASA(CW)) and the Congress of the United States.

The ASA(CW) approves or modifies the recommended plan and forwards it to the Congress. Congress has granted the ASA(CW) the authority to authorize and construct some plans under the Continuing Authorities programs of USACE. Plans recommended under these authorities do not have to proceed to Congress. A plan that proceeds to Congress must be authorized before it can be implemented. The authorization of a plan marks the final decision by the United States Congress to implement it as an actual project.

Whether the decision is ever acted on or not depends on the authorized project actually being funded for construction. This requires a budget agreement between the Congress and the President.

10.6 Five Points to Take Away

Here are five key points to take away from this chapter.

1. The four primary tasks in the Implementation stage are VT choice of the TLR and the TSP, assessment of the risks of the TSP, and USACE recommendation.
2. When the VT recommends a plan as the TSP, the tolerable level of risk is established.
3. Residual risks must be described and explained; new metrics for doing so are needed.
4. Decision-making at this stage is often messy and difficult to describe.
5. The PDT must conduct a risk assessment of the TSP as soon after it is identified as practical.

10.7 References

Yoe, Charles. (2002). *Trade-Off Analysis Planning and Procedures Guidebook.* Alexandria: Institute for Water Resources.

Chapter 11
Tell Your Story

"It has often been said
there's so much to be read,
you never can cram
all those words in your head.

So the writer who breeds
more words than he needs
is making a chore
for the reader who reads.

That's why my belief is
the briefer the brief is,
the greater the sigh
of the reader's relief is. –Dr. Seuss

11.1 Introduction

This chapter is more aspirational than descriptive or prescriptive. It does not describe the way reports are typically documented. The main purpose of USACE reports is generally considered to be to document that the recommended plan was developed in compliance with USACE requirements and all other applicable federal requirements in a reviewable manner. USACE guidance encourages the integration of the main planning report and the EIS. Content requirements for EISs are specified by federal regulations. There are requirements that must be met. However, there are more ways to meet those requirements than to simply replicate the last planning report the district produced. This chapter is about some of those alternatives for those daring enough to do things differently. So let us not begin subtly.

Do not write a report. Instead, tell the story of your plan and how it came to be the best plan of all the plans considered. Facts may not the

Eight Good Ideas for a Planning Story

1. Engaging beginning, interesting middle, satisfying ending
2. Narrative quality (no data dump, no default formats, no take the last report and add a little to it)
3. Chronology is your friend
4. No geek speak or acronyms
5. Cut to the chase-write it the way you'd say it and remember nouns and verbs beat adjectives and adverbs
6. User-friendly and informative figures and features (let people access data/info in the ways they like)—write on a map or a picture
7. Tie decisions and judgments to the evidence (say why you did what you did)
8. Tell the truth (no matter where it takes you)

best way to get your point across. They do not win people over or persuade them. An emotionally based story can have a much greater impact (Ruger 2010).

Causative stories are what you want to use to document your study. Why did you do what you did in the study? Why motivates much more than who, what, when, and where (although they can be important too). Whys go to motives, feelings, and emotions? Why reject the channel that everyone wanted? Why choose a wall instead? Why not use a sonic boom to keep the aquatic nuisance species away? Why not run the bypass through the farmland north of town? Why choose the plan that you did?

Oh, how planners love their data. Figure 11.1 shows an excerpt of a table that took seven pages (pp. 1158-1164) to run in the CERP report[11]. The effort that went into doing this cost-effective analysis of ecosystem management measures was prodigious. The codes indicate combinations of management measures that numbered 294 in total. The costs and amounts of water produced by each measure are also shown. It was important to do, it was a lot of hard work, and maybe someone somewhere cares about entry 209 on page 1162. However, the results are not nearly as interesting as why the team did this.

Cost Effective Combinations of Management Measures for Function C

COUNT	CODE													COST ($1,000)	OUTPUT (acre-feet)	AVG. COST ($1,000/acre-foot)
1	A0	B0	D0	E0	F0	G0	H0	I0	J0	K0	Z0	C0	X0	0	0	0.0000
2	A0	B0	D0	E0	F0	G0	H0	I0	J0	K1	Z0	C0	X0	369	582	0.6340
3	A0	B0	D0	E0	F0	G0	H0	I1	J0	K0	Z0	C0	X0	860	8,951	0.0961
4	A0	B0	D0	E0	F0	G0	H0	I0	J1	K0	Z0	C0	X0	972	51,702	0.0188
5	A0	B0	D0	E0	F0	G0	H0	I0	J1	K1	Z0	C0	X0	1,341	52,284	0.0256
6	A0	B0	D0	E0	F0	G0	H0	I1	J1	K0	Z0	C0	X0	1,832	60,653	0.0302
7	A0	B0	D0	E0	F0	G0	H0	I1	J1	K1	Z0	C0	X0	2,201	61,235	0.0359
8	A0	B0	D0	E0	F0	G0	H0	I2	J1	K0	Z0	C0	X0	2,691	67,170	0.0401
9	A0	B0	D0	E0	F0	G0	H0	I2	J1	K1	Z0	C0	X0	3,060	67,752	0.0452
10	A0	B0	D1	E0	F0	G0	H0	I1	J0	K0	Z0	C0	X0	3,095	68,051	0.0455
11	A0	B0	D1	E0	F0	G0	H0	I0	J1	K0	Z0	C0	X0	3,207	110,802	0.0289
12	A0	B0	D1	E0	F0	G0	H0	I0	J1	K1	Z0	C0	X0	3,576	111,384	0.0321
13	A0	B0	D0	E0	F0	G0	H1	I0	J0	K0	Z0	C0	X0	3,995	231,200	0.0173
14	A0	B0	D0	E0	F0	G0	H1	I0	J0	K1	Z0	C0	X0	4,364	231,782	0.0188
15	A0	B0	D0	E0	F0	G0	H1	I1	J0	K0	Z0	C0	X0	4,855	240,151	0.0202

Figure 11.1: Excerpt from a seven-page table in the CERP Report

No one cares as much about your numbers and facts as you do. When you tell a story, it is far more important to explain what the numbers mean and why they are important than it is to present the numbers. People care most deeply about the things that touch, move, and inspire them. Facts just cannot do that, however, you can connect to a story. Marcel Proust, a French novelist, said, "Facts do not penetrate the world of our beliefs. They haven't generated them; they

11 There is no intent to pick on this report; there are any number of reports that could have been selected for the same reason. This report was chosen for its high visibility, its availability, and the excellent manner in which the planning team learned how to tell its story. Explore their wonderful storytelling website at http://www.evergladesplan.org/

do not destroy them. They can inflict the most constant contradictions upon them without weakening them." Proust was right.

People are up to their eyeballs in information; they do not want more information. They want to have faith in the plan and in the story you tell about it. Faith moves mountains, not facts, and facts do not give birth to faith. Once people make your story their own, they will have faith in your plan (Simmons 2001). This chapter is about how to tell your story.

The Central and Southern Florida Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement (1999) was the basis for the Comprehensive Everglades Restoration Plan (CERP). The report has 4,034 pages. The Final Feasibility Report without Annexes is 592 pages in length. The story of this comprehensive plan is much, much shorter.

Now, let us double back on the opening line; do not write a report. This chapter is not about report writing it is about storytelling, but sometimes you are going to need a report. You may need an EIS, and it has certain requirements. There has to be some technical review of your study, its data, analysis, and conclusions. You can dump data, detail your analysis, and provide your conclusions in all their glorious detail in as many technical appendices as you like. These we leave to you. The story of the plan is what we want here.

Here is what you can expect in this chapter. The elements of a good story are the first topic. Reports tend to dump data and follow a process rather than offer a chronological description of the way the action unfolded. It would not be unusual to see a planning report structured around the six steps of the P&G planning process for instance. So, how does a story differ from a report? The answer is by its structure. Six classic story structures are offered for your consideration. The hope is one of them and a few of the other story elements described might suit your storytelling needs. Seriously, pick a story structure, then construct your story.

Write simply. It is not that hard. Simple words and short sentences are a good start. This is the message of the chapter's third section. A readability index is described to help you gage how complex your narratives are. A number of rules for writing simply are offered.

Risk and uncertainty probably ought to be characters in the stories you write and you will find a section on each. Use pictures. Photographs, maps, graphs, charts, and all manner of figures to make your story more interesting and more effective. These are the subject of the next section.

The final chapter topic is documenting your story. It differentiates between planning documents and documenting planning. Think of the former as formal reports and the latter as the storytelling we have been talking about. They need not be separate tasks, but they can be at times. Many planning contexts require formal reports. Once a written report was the only way to tell a story. That is no longer the case. Video reports and multimedia websites with 360-degree virtual tours, animations, games, and puzzles can do the job now. Planners can use YouTube videos, Facebook pages, Pinterest, Flickr, Snapchat, Tumblr, Instagram, Path,

What are the characteristics of a great report?

It is easy to read.

It uses plain language.

It has maps and graphics.

It tells your story.

It is brief.

It answers all the why questions.

It provides recommendations.

blogs, tweeting, web conferences, discussion boards, wiki spaces, and the next neat thing as well, throughout the planning process. They become part of the living history of the plan and a valuable part of the story or the report, as planners' needs dictate.

11.2 Elements of a Good Story

Do not overthink this idea of storytelling. It is not that complicated. Your story is for decision makers and interested stakeholders. Technical reviewers can be satisfied with technical appendices; that is where you want to dump your data and trot out your facts. You do want to tell a story, and there are better and worse ways to tell one. Most studies will be documented in writing, so let us begin with five simple and effective storytelling suggestions.

Hero/Villain Pairs

Fish/acid mine drainage

Indigenous plants/non-indigenous plants

Water quality/phosphorous

The port/sedimentation

First, engage your audience. Grab your reader's attention so they can focus on your story and want to hear more. Jump right into the story, do not clutter things up with *administrative requirements* that add nothing to your story and that can be relegated to an appendix.

Second, build the scene. You want people to care about the study, so create an immersive experience in your narrative. Tell your story in a way that makes the reader feel like they are there. Begin with some useful context then continue your story scene by scene by using details that enable them to picture the action and feel the things you felt. If you did not think there would be a Federal Interest at first, say that and help the reader understand what was at stake and why you thought that so they will be interested in learning how you resolved that issue. Tailor your language for storytelling, do not be afraid to use words that create strong specific emotions.

Tension and Release

The local sponsor really wanted the river dredged to manage flood risk…until they learned it would take an area as large as all of downtown to confine the dredged material.

Third, build tension and release tension. The story of your plan has an arc, and you should be building tension until the climactic point in the story, your recommendation. As you build tension points in your story, remember to release the tension as well. If you do not release tension, your story will feel rushed or too much like a list: and then, and then, and then. Let your narrative include little pauses between the things that happened in your study. Use these releases to set the scene or to fill in with a few less essential details.

Fourth, focus on what is important. A good story needs to include details to create that sense of immersion you want, but you do not want the story to ramble. Therefore, focus on what is important. Cut out the details that are not important for the story and leave the ones that make the story pop.

Fifth, keep the flow logical. Know your story. Do not jump back and forth in time. Do not go off on tangents. Do not fail to finish a scene. In other words, do not interfere with the reader's experience of the story. Tell the story in a way that flows smoothly. If your story is complex, figure

out what is essential and what is not, then stick with the essentials. If you forget a detail, do not tack it on; rewrite to include it where it belongs.

A good story needs an engaging beginning (once upon a time…), an interesting and informative middle that moves the story along (consider a talking mirror), and a satisfying ending (they all lived happily ever after). Compare this time-tested formula to the actual report format outlined in the text box on the next page. The Introduction of this report took nine pages and never got to once upon a time. If you want people to read and care about your study, you must engage them from the outset. An alternative beginning might be something like, "*As a direct result of the 2007 flood that killed eight people and did $500 million in damage, Congress directed us to look for ways to reduce the flood risk, and we think we have done that.*"

How Not to Prepare a Report

Get the last report your office did.

Do everything they did.

Add some new stuff to it to prove your value.

Watch the report get thicker and thicker.

Stories get lost and forgotten.

The middle of the same report reads like a dump of facts, some of which are no doubt important to the story, but how would you find them or know they are important in a report structure like this? This report took up about 200 pages. It is outlined above because it is a standard outline, and it provides us with the opportunity to say, do not do this. There is no good reason to write a report like this.

Good stories do not just happen. Always remember you are telling a story; keep your plot and your reader in mind. Many planning stories are best told as a narrative of events. A chronology is helpful; use it to order your story: first this happened because… then that happened because...

Planning reports that use the steps of the planning process, as shown in Exhibit 11.1 impose a narrative order that is artificial and likely to be confusing to the reader. If the study began when the mayor came to your office and said, *This is what we'd like you to build,* then begin your story there. Tell the reader how the study unfolded. Tell the story of how you went from that first day to the recommendation in your study and answer all the why questions along the way.

Planography

To this traditional archetype, I add a variation, the invention of Ken Orth, the "Planography." This is the biography or life history of a plan. It's a diary. It begins with what you did the first day of the study and it ends with the decision. Be sure to include explanations of why things were done and why decisions were made. This is the chronology of the planning process in a rich narrative.

Exhibit 11.1: Representative example of a standard structure for a USACE planning report

1. INTRODUCTION
- a. Study Authority
- b. Study History
- c. Study Participants and Coordination
- d. Study Purpose, Location and Scope
  - i. Study Purpose and Scope
  - ii. Geographic Location
- e. Related Studies and Projects
  - i. Studies
  - ii. Projects
- f. Format of Report

2. EXISTING CONDITIONS
- a. General History
- b. Physical Conditions
  - i. Climate
  - ii. Geology and
  - iii. Topography
  - iv. Streams
  - v. Hydrology and Hydraulics
    1. Hydrology
    2. Hydraulics
  - vi. Social and Economic Conditions
    1. Land Use
    2. Transportation
    3. Population
    4. Recreation
  - vii. Environmental Characteristics
    1. Air Quality
    2. Water Quality
    3. Wetlands
    4. Threatened and Endangered Species
    5. Terrestrial and Aquatic Habitat
  - viii. HTRW Assessment
  - ix. Cultural Resources Baseline

3. PROBLEMS, OPPORTUNITIES AND CONSTRAINTS
- a. Problems
  - i. Historical Flooding
  - ii. Floodplain Characteristics
  - iii. Flood Damage Assessment
- b. Opportunities
  - i. Flood Damage Reduction
  - ii. Ecosystem Restoration
  - iii. Recreation
- c. Constraints
  - i. Technical
  - ii. Economic
  - iii. Environmental
  - iv. Regional and Social
  - v. Institutional

4. FUTURE WITHOUT PROJECT CONDITION
- a. Transportation
- b. Population and Land Use
- c. Hydrologic and Hydraulic Changes
- d. Environmental Trends

5. PLAN FORMULATION
- a. Formulate Alternative Plans
  - i. Planning Objectives
  - ii. General Plan Selection Criteria
  - iii. Assessment Procedure
- b. Qualitative Assessment of Measures
  - i. Evaluation Criteria
  - ii. Preliminary Assessment of Individual Measures
- c. Quantitative Screening of Measures
  - i. Design Criteria
  - ii. Economic
  - iii. City of Davis – Detention Dams
  - iv. City of Davis – Eagle Creek West Diversion to Blanchard River
  - v. City of Davis – Levee and Floodwall Measure
  - vi. City of Davis – Nonstructural Retrofits
  - vii. City of Davis – Blanchard to Lye Containment
  - viii. Village of Thomas – Levee and Floodwall
  - ix. Village of Thomas – Channel Realignment with Detention
  - x. Village of Thomas – I-9 Bridge Modification
  - xi. Village of Thomas – Nonstructural Retrofits
  - xii. Summary of Findings
  - xiii. Measures for Continued Analysis
  - xiv. Data Gaps and Additional Studies
- d. Selection of Alternatives
  - i. Development of Structural Alternatives
  - ii. Hydrologic and Hydraulic Analysis
  - iii. Economic Analysis
  - iv. Selection of Structural
- e. Evaluate Alternative Plans
- f. Compare Final Array of Alternative Plans

6. ENVIRONMENTAL EFFECTS AND EVALUATION
7. ENVIRONMENTAL COMPLIANCE
8. COORDINATION, CONSULTATION, AND PUBLIC INVOLVEMENT
9. LIST OF PREPARERS
10. DISTRIBUTION LIST
11. GLOSSARY AND ACRONYMS
12. REFERENCES

Endings need to provide a sense of closure. There should be nothing important left unsaid. All loose threads in the report must be tied up by the end. Clear, unambiguous endings are best. Planning studies have a natural ending: the recommendations and steps necessary for implementation.

11.2.1 Engaging Your Audience with Characters and Plotlines

Engaging your audience emotionally with your story is easier if you have characters they can identify with. The most engaging characters are often from the natural environment, and it takes a special touch to make coral, an ecosystem, endangered species, or any other warm and fuzzy valued resources sympathetic characters. It also takes a deft hand to keep from injuriously portraying some human actors as villains. Nonetheless, developing heroes and villains can be an important part of the storytelling strategy. Imagine natural floodplain values as the hero and unrestrained development over years as a villain. Now reimagine good and vulnerable citizens as the heroes with a villainous flood threat. These are dicey balances to strike, but if you can do it, you have a more engaging story.

The story is also going to need action, something that drives or impels it forward to a climax. The nature of the problems and opportunities or the actions of the PDT often can provide that drive. If you are going to build and release tension, it can help to build your story on conflict. Here are six sources of conflict (Ruger 2010), all of which are typically plentiful in water resource planning studies. Consider using one to move your story forward, they are:

- **Man vs. Man**—includes relational conflicts among people, e.g., conflicting stakeholder interests
- **Man vs. Himself**—includes the internal conflicts we experience individually and as a community or species, e.g., the twin desires of economic development and reducing our footprint
- **Man vs. Society**—includes social conflict involving a specific group of people, e.g., environmental justice, social justice, and social vulnerability issues
- **Man vs. Natur**e—includes external conflicts between the natural and the material worlds, e.g., development of floodplains
- **Man vs. Machine**—includes a conflict with technology, e.g., strip mining or fracking
- **Man vs. Fate—**includes internal or external conflict with the moral, ethical, or supernatural, e.g., animal welfare, issues

Commit, as a team, to telling a story. Choose a simple plot line. Now consider some suggestions for telling a good story simply.

11.2.2 Who are Your Audiences?

Planning documents fulfill several purposes. One of the major purposes of a planning document is to show that the planning process is in compliance with USACE requirements and all other applicable federal requirements. A second common purpose is to support a technical review of

the planning process and its results. These two purposes lead to reports written by USACE for USACE. They also result in bloated documents filled with so much information that it is often impossible to find the study's story. If that process is working for USACE, there is no reason to deviate from it. However, there may be more audiences whose needs are not being met by this method.

Part of the challenge in documenting planning is to realize there are a great many audiences for a USACE planning investigation, among them are:

- USACE
- Resource agencies
- Office of Management and Budget
- Local sponsor
- Affected communities
- Technical experts
- Contractors and consultants
- Other stakeholders

Different audiences come to the study with different background knowledge, experience, training, and points of view. They will need to know different things because they intend to use the information in different ways. These different audiences may require different voices and different vocabularies. USACE can continue to produce its typical report document and rely on others in the media to interpret it for other audiences, or it can choose to address those key audiences directly. Storytelling benefits all of these audiences. Tell the story first and then figure out how you want to meet those other reporting requirements. If that problem turns out to be intractable, then perhaps a single document is insufficient for the many audiences. External or interpretive summaries may be necessary for different audiences.

11.3 Write Simply

Ernest Hemingway learned and used four rules for writing simply while working for the Kansas City Star. They are:

How Many Writers?

Planning reports are often written by the various team members, and they read like it too. Everyone writes his or her part, it all gets stapled together, and it is called a report.

Not all writers are equally gifted. Not all use the same writing style. Few things are more annoying to a reader trying to understand a complex issue than to try to wade through a poorly organized report written by a dozen people in a dozen different voices who apparently never spoke to one another or bothered to read what the others had written. That does not mean it must be written by one person, but it probably should be.

1. Use short sentences.
2. Use short first paragraphs.
3. Use vigorous English.
4. Be positive, not negative.

Planners could do a lot worse and frequently do. Write so your reader understands you.

11.3.1 Readability Indices

A number of readability indices have been developed to help writers gage how appropriate their writing is for their readers. The Flesch-Kincaid Grade Level Readability Test is one that is available with Microsoft Word. This index is described by this rather opaque formula:

$$FKRA = (0.39 \times ASL) + (11.8 \times ASW) - 15.59$$

Who is Your Reader?

The purpose of a report is to communicate ideas to another person. The first and most important question the writer must ask is who is my primary reader. Once you identify the reader, empathize with her throughout the writing process. Put yourself in the reader's position. Do not write for the study team or for your own personal glory. Write for that person who is going to be reading. Tell her your story in a way that she can understand it. A report written for a technical reviewer or an expert with intimate knowledge of the problem is going to be very different from a report written for Jane Q. Public.

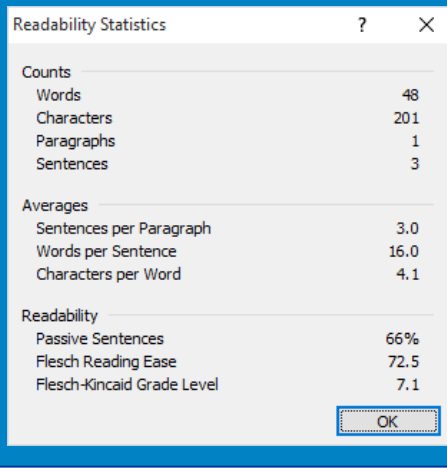
Where, FKRA = Flesch-Kincaid Reading Age, ASL = Average Sentence Length (total number of words divided by the total number of sentences), and ASW = Average number of Syllables per Word (total number of syllables divided by the total number of words). The FKRA result is the appropriate reading level for the tested reading material. A score of 7 means a seventh grader would be expected to read and understand this material, a college graduate would be able to handle material with a score of 16.2. Let us try it on the opening paragraph of the CERP report, which follows:

"The Central & Southern Florida (C&SF) Project extends from south of Orlando to the Florida Keys and is composed of a regional network of canals, levees, storage areas and water control structures. First authorized by Congress in 1948, the project serves multiple purposes. The authorized purposes of the project include flood control, regional water supply for agricultural and urban areas, prevention of salt water intrusion, water supply to Everglades National Park, preservation of fish and wildlife, recreation and navigation. For close to 50 years, the C&SF Project has performed its authorized functions well. However, the project also has had

unintended adverse effects on the unique natural environment that constitutes the Everglades and south Florida ecosystem."

The FKRA for this paragraph is 15.1. That makes the material suitable for an advanced college student. An oft-repeated ideal target for mass consumption reading is an index of 7 or 8. Anything above 12 is generally regarded as too hard for most people to read. If you want to be understood, write simply.

In Word 2016, the index is found on the Review tab in the Proofing cluster as part of the Spelling & Grammar function. If it is not already available, it can be added through the Word Options found on the File tab. Here is the index for this textbox.



11.3.2 A Few More Simple Writing Rules

Avoid acronyms and jargon. You may find PDT, PED, SQRA, PAS, FPMS, DSOG, and LSAC second nature. Normal people do not. There are no acronyms or jargon in stories. Habitat units, expected annual damages, thalwegs, and hydrographs make your message unclear. Do not use words you avoid when you speak with your children or non-planning or non-scientific friends.

- **Avoid ambiguity and abstractness.** Remember, words mean different things to different people. If you say an event is likely, you have not provided any useful information. Be clear.
- **Avoid long words.** Obfuscation does not imply profundity.
- **Kill those euphemisms.** A flood is not a wet water event. A gas station attendant is not a petroleum transfer engineer, and a school bus is not a motorized attendance module.
- **Check the logic of your sentences.** When we are unclear about what we intend to say, we use too many words. Each sentence should make common sense.
- **Avoid cop-out phrases.** If you are sorry, do not say mistakes were made.
- **Do not mummify your thoughts.** A common mistake in reports and other kinds of writing that are intended to inform and enlighten the reader is to take a good basic idea and then wrap so many meaningless, empty, extraneous, unnecessary words around it that the meaning and very essence of your thought gets lost amongst the words that exhaust you to read.
- **Do not attempt humor in a report.** Humor is a very personal thing, and you are not going to hit the target with every reader. See the previous paragraph for an example. Was it funny to you? It was to me.
- **Avoid sexist language.** No matter how you personally feel about it, it does attract attention these days. If it is natural to use gender-neutral words, do so. Alternate male and female pronouns now and then if gender neutrality becomes clumsy. Avoid nonsensical solutions to this modern sensitivity like (s)he, S/he, or she/he.

- **Keep explanatory material on target.** Make sure that what you are writing contributes to the story you are telling. Focus more on telling your story and less on reporting requirements. Get to the point.
- **Enumerate.** Lists are your friends. Enumerate facts, ideas, instructions, questions and the like in lists. They have more visibility than text, they conserve space, and they convey ideas in a powerful way.
- **Do not let the subject and verb get too far apart.** This problem often plagues writers dealing with a technical subject matter.
- **Always use spell check**. Proofread and edit your work. Do not write anything once; you are not that good.

12 Simple Writing Rules

1. Verbs has to agree with their subjects.
2. Prepositions are not words to end sentences with.
3. And do not start a sentence with a conjunction.
4. It is wrong to ever split an infinitive.
5. Avoid clichés like the plague. (They are old hat)
6. Be more or less specific.
7. Parenthetical remarks (however relevant) are (usually) unnecessary.
8. Also, too, never, ever use repetitive redundancies.
9. No sentence fragments.
10. Do not use no double negatives.
11. Proofread carefully to see if you any words out.

Source: Learning with e's http://steve-wheeler.blogspot.com/2010/04/12-writing-rules.html Accessed February 13, 2012

11.4 Risk Management

The risks the PDT are addressing are likely to be a primary source of tension in your story. What are you doing to protect lives and property from floods? Are you willing to take a risk by deepening or widening a channel that could produce substantial benefits for the nation and jobs and income for the regional economy? Your story needs to address the risks identified in the scoping process as focal points for the study.

Residual Risks

Flooding – describe the magnitude, frequency, and nature of floods that could exceed the capacity of the plan and result in damages or risk to life

Navigation – describe the resulting risk of marine casualties and the likelihood that the transportation cost savings will not be realized

Ecosystem restoration – describe the likelihood that the expected ecosystem benefits will not be realized.

An effective story will identify the risks that the community will face if no federal action is taken and it will effectively describe how the TSP will reduce the risks of loss and enhance the opportunities for uncertain gains. The reader should have a clear understanding of what is to be gained by a federal project. Risk reductions should be described clearly for the reader. Decision makers need to understand the risk improvements that will be realized. Reduced losses and enhanced gains need to be described with risk estimates and risk narratives appropriately chosen for the reader.

One of the most important parts of the story is the story of residual risk. Residual risk is the risk that remains after a federal plan is implemented. Avoiding risk is rarely an option; when it is not, there will always be some risk that remains after the TSP is implemented. These risks need to be carefully estimated and conveyed to stakeholders and the public. They are an important part of the story. When residual risks are significant, they may warrant another formulation iteration to identify options for addressing them. Any significant risk identified in the TSP risk assessment also needs to be carefully identified and either addressed by the plan or in subsequent PED work.

It is assumed that study and implementation risks that remain after the TSP is identified are communicated within the USACE and outside of the study documentation process.

11.5 Explain Uncertainty

Risk-informed planning is intentional in the manner in which it addresses uncertainty and the risks that arise from that uncertainty. Consequently, how the PDT has handled uncertainty is a substantial part of the story. What was unknown when you started? What did you do to reduce that uncertainty? How did you use the knowledge you gained? What remains uncertain? Why and how is that uncertainty important to stakeholders and the public? How might the remaining uncertainty change the outcomes of the project?

Explain uncertainty. In fact, proclaim significant uncertainty that remains. Explain that the risk is uncertain. Explain what you think the consequences and probabilities are; tell the reader how much confidence you have in your opinions. Explain the evidence you have to support your view; tell the reader what additional evidence you wish you had but do not. Explain what other experts think and the extent to which they agree or disagree; provide the basis for any disagreement. Explain what you are doing to reduce your uncertainty, tell the reader when you might have more information, and what you will do with that information. This is how you frame any discussion of risks.

11.6 Use Graphics

Use graphics to tell your story. Graphics include pictures, maps, charts, tables, drawings, numbers, illustrations, graphs, diagrams, blueprints, artist's conceptions, and virtually any kind of image you can imagine. You should expect to use very different graphics to support decision-making than you would use to tell your story to the public. In this section, we will focus on storytelling graphics. What kinds of things might you do to illustrate your story?

- Show a map – this is where your story takes place.
- Show important places on a map and include ground level photographs as map inserts.
- Use pictures to illustrate problem conditions.
- Photoshop photographs to show improved conditions.
- Draw on a map – go easy on the blueprints, the public does not understand them.
- Show your team at work – let people see the fieldwork and the equipment you used.

Photos of the team collecting data will be more interesting to people than the data. Is the valley elderberry longhorn beetle habitat important to your study? Show people what it looks like and tell them why people care about an insect. Show its ideal habitat and then show the available habitat. Tell a story, do not just dump facts.

Make sure people understand why the facts are important, before you dump facts. Then dump them in bullet lists or good graphics.

Use a horizontal format for tables; the eye tends to scan from side-to-side better than up-and-down. Limit your tables to nine rows and sort them with the largest numbers at the top. Align your data on the decimal point, and if you need more than two significant digits, rethink what you are doing.

Edward Tufte's (1983) principles of graphical excellence say use a well-designed presentation of interesting data. The goal is to communicate complex ideas with clarity, precision, and efficiency. Tufte advises giving the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space. Above all else, an excellent graphic shows the data and tells the truth about it. Tufte's web site http://www.edwardtufte.com/bboard/q-and-a-fetch-msg?msg_id=0002w4 (Accessed July 13, 2016) provides examples that should stir the imagination of planners. It is worth a look.

Bigger graphs are not always better than smaller graphs. Sets of thumbnail sized graphics on a single page can be used to represent different aspects of a single phenomenon. The Florida Museum of Natural History provides a great example of multiple small graphs showing shark attack by location and population size over time https://www.flmnh.ufl.edu/fish/sharks/statistics/pop2.htm (Accessed July 13, 2016). Multivariate displays like this support comparison and enhance the dimensionality of your story. These multiple minis, several small graphics on a page, can tell a rich story compactly. They are well suited to show alternatives or a range of options. If you are not telling your story in print, the potential for using visual displays explodes. You will find more ideas for visual storytelling in the last section.

11.7 Documentation

The traditional view of documentation is a planning report. Modern documentation includes both storytelling and reporting your study findings so decisions can be made. A main report ought to tell your story. Technical appendices can cover all reporting requirements, analysis, and data. Planning documents and documenting planning might require different skill sets; each is discussed in turn.

11.7.1 Planning Documents

This is the required documentation. The government has financed your plan, and you owe them some answers. The PDT must follow the NEPA process. This requires either an EA and a FONSI or an EIS and a ROD. Satisfying the needs of higher authorities is the most important reason for documenting the planning process. When they direct the way you should do it, do it as directed.

This kind of planning report serves two purposes; it is an analytical report and a decision document. As an analytical report, it identifies a problem; analyzes, synthesizes, and interprets pertinent information; and presents conclusions and recommendations for appropriate action. As

a decision document, it informs readers of the decision made and the reasons for it. The format for a planning report varies with the magnitude of the study. It can be anything from a letter report of a few pages to a main report with appendices that can run into the thousands of pages. With maps, graphics, editing, writing, printing, distribution and related costs, documentation can be an extremely expensive part of the planning effort.

Planning documents will include a number of technical appendices. This is where you include the data that must be shown and where you describe the analysis that must be explained. The USACE has been doing reports like this for a long time, and it needs little help in preparing them. Instead, let us turn our attention once more to some alternative ways to document the planning process and tell your story.

11.7.2 Documenting Planning

It is when documenting planning that the PDT has the greatest freedom to tell its story. It can be told in writing in a traditional report format, but it need not be. Consider using other media to tell your story. Some of these, as you will see, increase the opportunities for stakeholder and public involvement in the study process even as they tell the story of your study.

11.7.2.1. Personal Communication as Documentation

Here is a radical idea for this age of technology, put the technology down and talk to people. Tell them your story. Make it personal. Face-to-face communication as documentation! There are lots of ways to do that.

Briefings, large and small group meetings, guest speaker engagements, news conferences, making presentations, manning exhibits and displays at fairs and such, participating in panel discussions, sponsoring field trips, relevant training sessions, walking tours, classes, sponsoring symposia, and holding focus groups are a few ways planners can get out among interested people. Media interviews, hotlines, and talk shows are one step removed from face-to-face encounters. Mailings, newsletters, and news releases are other ways to reach interested individuals.

11.7.2.2 Digital Stories

Make a video and upload it to YouTube. Get your youngest niece or nephew to show you how if you do not know. Digital technology has radically changed the way you can tell your story.

Virtual tours enable people to visit distant and hard to reach places. They are also effective teaching aids for unfamiliar concepts. The USACE provides a virtual tour of the Kissimmee River aquifer storage and recovery pilot facility at http://141.232.10.32/pm/projects/asr_tour/asr_interactive.aspx (Accessed July 13, 2016). Virtual tours are an excellent tool for documenting conditions, solutions, and many other aspects of a planning study.

Interactive maps are a great way to present facts to people. They enable interested individuals to explore the data of interest to them. Charlotte-Mecklenburg present a three-dimensional Interactive Floodzone Map http://meckmap.mecklenburgcountync.gov/3dfz/ (Accessed July 13, 2016) that offers the ability to explore the risk of individual floodplain structures. The point and click technology enables interested parties to discover and explore a wealth of data, to find the information that is most interesting and useful to them.

Photo galleries enable people to see realistic images of conditions at a planning site. Animations have become comparatively easy to prepare with the advent of software like Macromedia Flash. Photography in the round, 360-degree photography, is a great way to take people to places that are an important part of your story. An outstanding example of the promise of this technology in storytelling is found at http://www.360cities.net/ (Accessed July 13, 2016). Just grab your cursor and start rotating the image. Search for the Strahov Library indoor tour. Use the zoom feature and notice how the details of an individual book can be displayed. Now think about how to use this technology to tell your story.

Interactive databases are another promising technology. They enable planners to think less about what table to present and more about how to make the data available so users can access it in ways that are meaningful to them. One of the very best examples of an interactive database is provided by Gapminder (http://www.gapminder.org [Accessed July 13, 2016]). This compelling site enables the user to explore the world over time from a desktop. Have a look and imagine how to adapt these technologies to your planning studies.

Many of the other tools are not nearly as dramatic by comparison, but do not overlook the obvious. Enabling people to download reports, documents, databases, maps, audio files, video files, photographs, and other forms of digital information from a website can empower your most interested publics to get involved and informed.

Combine digital stories and personal communication. Use web conferencing to hold a virtual meeting or a question and answer (Q&A) session with the planning team. Bringing in an expert to answer the public's questions about an especially lively issue is a great use of the technology. Host a panel of experts with varying perspectives on an aspect of your study to help people understand the uncertainty that remains in your story. This leads naturally into the use of podcasts as a means of telling your story. A permanent and growing library of strategically created podcasts could be valuable storytelling resources.

An electronic mailing list or listserv can be created, managed, and used to communicate in an ongoing way about aspects of your story that prove to be of particular interest to people. Consider creating a listserv for your study early in the planning process that enables you to tell your study's story in real time. Discussion boards and chat rooms can also be used to enhance communication about your story.

Collaborative work spaces may be worth exploring. Wiki spaces enable interested parties to work collaboratively on problem solving and other creative efforts throughout a study process. This enables stakeholders and the public to help write the story. A wiki space would be a great place to ask the public to share their ideas on how to solve the problems you face and to become part of the story.

Puzzles and games provide a great way to document a story for young people. World of Warcraft https://us.battle.net/account/creation/wow/signup/;jsessionid=342BCB32C1C893C5874566EC79D14C7E.blade34_01_bnet-mgmt (Accessed July 13, 2016) provides a great example of how games can be used to engage many people in virtual exploring, problem solving, and other strategic activities. How long before some daring pioneer creates a game designed to help solve a wicked planning problem?

Pokémon Go offers a fascinating mix of technology and reality that opens doors for exciting adaptations of this new technology by planners. Imagine the ability to walk a plan's footprint with this new technology and see features of the plan as they might look. It is all planning fantasy at this point, but all it will take is a courageous planner to change the way stories are told.

As promising as these digital media are, do not overlook the digital divide. The digital divide refers to the inequalities among groups in terms of their access to, use of, or knowledge of information and communication technologies. Make an effort to become aware of the digital divide among your study's many publics when you consider using this technology.

11.7.2.3 Social Media

Having a web presence for your study may be more important to stakeholder and public involvement than to storytelling, but it can be an effective tool for storytelling. How important is a web presence to your study?

Social media are often defined as a group of Internet-based applications that allow the creation and exchange of user-generated content. Social media are used for social interaction. This is considered to include but also go beyond social communication. Important features of these media are their ready accessibility and scalability. Both individuals and organizations can make use of these media. What better place to look for examples of social media than Wikipedia, one of the world's foremost examples of what collaborative people with access to technology can do? Wikipedia breaks social media into communication, collaborative, multimedia, reviews and opinions, and entertainment categories. Examples of each follow.

Communication includes blogs, microblogging, Twitter, social networking (e.g., Facebook), events, information aggregators, online advocacy and fundraising, and engagement advertising and monetization. Many resource planning agencies can already be found on Facebook. Creating new accounts for specific studies is the next logical step for all who want to friend or follow a study. As the story unfolds, it can be told with these kinds of media. Consider Twitter or Pinterest. Let people follow your study. A couple of updates every week or two keeps interest alive. Stakeholders can and also do make use of these media to present their own views on issues. A Twitter account for the planning team's use adds opportunities for immediacy and intimacy heretofore impossible to imagine.

The collaboration and authority building media include things like wikis, social bookmarking, social media gaming, social news, social navigation, and content management systems. Wikis may be one of the more popular and promising collaborative environments for planners to exploit. Wikis can be used throughout the planning process. Publish the team's problems and opportunities statement and ask, *Did we get it right? What's missing that ought to be here? What's here that ought to be missing*? Let people wordsmith. Do the same with objectives, and then use wikis to ask for help with identifying solutions. A wiki space that includes that kind of collaboration with the public provides a powerful piece of the story itself.

Multimedia opportunities are exciting. They include photography and art sharing, video sharing, live casting, music and audio sharing, and presentation sharing. Two existing examples are especially exciting. Flickr is a service that enables people to upload and share their photographs. Sharing photographs of study areas has promise. Asking people to share historical photos from an

affected area could be a good source of information and data. Sharing those communal visions of the past, or of existing conditions, is a great way to tell a story. Instagram provides opportunities for video sharing. Study area videos are no further away than your cellphone. Let people see the study team when they visit the study area. Tumblr supports multimedia blogging in a convenient way. Photo sharing capability can be built into a study website, or media on the Internet can be used directly.

YouTube and Vimeo are two sites that are especially promising. Think of all the ways you could use video to help tell the story of a planning study. You could ask citizens to make their own videos showing problems or opportunities or explaining the history or importance of the area. You could sponsor a contest for the best historical video, the best video depicting a problem, or the best video that tells the story of a local species. Make these videos part of the study website. The possibilities are unlimited.

Reviews and opinions frequently are used to review products or businesses. They have also been used as a sort of community Q&A at sites like Wikihow, Ehow, and the like. This is an idea readily adapted to a planning study. Ask people to review your product as you go. Have them review your hydrology if you like or your EIS. The dialogue becomes an important part of your study's ethnography.

The final major category of social media is entertainment. It includes things like media and entertainment platforms, movie reviews, virtual worlds, and game sharing. Some of these have already been touched on. Meanwhile, the world waits for a creative planner to show us all how to use these tools to enhance the planning story.

11.7.2.3 Video Reports

If Steven Spielberg offered to tell the story of your plan in a movie, would you say yes? How much time would he spend talking about authorities? How much data would he show? Mr. Spielberg is not making a movie about your plan, but you still can. A carefully scripted 10- or 20-minute video might tell your story better than any written report ever could. If you think writing a report is difficult, try scripting an effective video. This is a job that requires expertise. That expertise can be purchased or acquired through the school of hard knocks.

If you are willing to enroll in that school, start videotaping the study area, the resources, the heroes, the villains, the affected communities, stakeholder groups, team meetings, interviews, field visits, people

The Seven Elements of Digital Storytelling

The Center for Digital Storytelling in Berkeley, California is known for developing and disseminating the Seven Elements of Digital Storytelling, which are often cited as a useful starting point as you begin working with digital stories.

1. Point of View – What is the main point of the story and what is the perspective of the author?
2. A Dramatic Question – A key question that keeps the viewer's attention that will be answered by the end of the story.
3. Emotional Content – Serious issues that come alive in a personal and powerful way and connect the audience to the story.
4. The Gift of Your Voice – A way to personalize the story to help the audience understand the context.
5. The Power of the Soundtrack – Music or other sounds that support and embellish the story.
6. Economy – Using just enough content to tell the story without overloading the viewer.
7. Pacing – The rhythm of the story and how slowly or quickly it progresses.

Source: http://digitalstorytelling.coe.uh.edu/page.cfm?id=27&cid=27&sublinkid=31

(Accessed September 27, 2015)

working, bits of everything you do. Build a library of clips early and continue it throughout the study. You will have to learn about release forms, lighting, and angles, and you might still need some professional help to pull it all together the first time. Printed reports are so yesterday, and you know you want to be so tomorrow.

11.8 Five Points to Take Away

Here are five key points to take away from this chapter.

1. Stop dumping facts and start telling stories.
2. Good stories have an engaging beginning, an interesting middle, and a satisfying ending.
3. Write your story simply.
4. Use graphics and pictures to tell your story.
5. Proclaim the uncertainty in your story.

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Chapter 12
Ongoing Process—Stakeholder Engagement

"It's a troublesome world. All the people who are in it are troubled with troubles almost every minute." – Dr. Seuss

12.1 Introduction

Stakeholders are at the center of this planning process. These are the people for whom you are planning. Think of *the public* as anyone who is not on the PDT. Now, understand there is no such thing as *the public*; in fact, there are many different publics. A special subset of these publics are stakeholders, groups with a special interest in your planning investigation or its outcomes (See textbox). The PDT needs to involve all of these people in meaningful ways.

The Planning Guidance Notebook provides these definitions.

a. Public. The public refers to any entity outside the USACE. The public includes federal, tribal, state, and local government entities and officials; public and private organizations; individuals; institutions; study sponsor representatives; community groups; and populations of interest from an environmental justice or social vulnerability consideration.

b. Stakeholders. Stakeholders include any member of the public that might be able to affect, are affected by, or are interested in, the results of the USACE planning process. They are people or groups who see themselves as having rights and interests at stake, either directly or indirectly. Some people may not realize they are stakeholders, i.e., affected by a USACE study such as socially vulnerable populations. Federally recognized tribes (including Alaska Natives) are not considered stakeholders due to their sovereign status.

Involving stakeholders takes more time in the short run. It is time-consuming, and it requires resources. In the long run, you get better information and more successful solutions because public support is needed for successful planning. Stakeholders live with the problems, and they benefit from the opportunities. They are also the people who can support you or oppose you in court when the process turns adversarial. Stakeholder engagement often saves time in the long run. If you do not involve stakeholders effectively, you are likely to live to regret it!

There is a rich literature on the value of stakeholder engagement. There are also some differences of opinion on terminology. Some say public participation or public involvement, others prefer stakeholder participation or involvement. The textbox above delineates a clear difference for the USACE planning community of practice. However, we live in a world of divided opinion, and in order to properly represent the ideas of others, we will use public involvement and public participation at times. When that occurs, think of it as a synonym for stakeholder engagement and participation. Jim Creighton's *The Public Participation Handbook* (2005) is one of the best portals of entry to this literature and the public participation process. He says public participation incorporates public concerns, needs, and values into government and other public decision-making processes. Quite simply, stakeholder involvement produces better decisions that are supported by the public.

This chapter has two themes. The first is a rather traditional look at stakeholder engagement. The second considers how stakeholder engagement changes in risk-informed planning. The first theme is addressed in Sections 12.2 through 12.5. These address:

- Five levels of stakeholder engagement and where they occur in the planning process
- The importance of identifying stakeholders as well as their levels of power and interest
- Some of the growing number of means of providing for stakeholder engagement
- When to engage stakeholders

The second theme is addressed in Sections 12.6 and 12.7 and include:

- Risk and risk communication
- Communicating uncertainty

12.2 What Is Stakeholder Engagement?

Stakeholder engagement is one of two continuous processes, along with evidence gathering, that is essential to the success of the planning process. Stakeholder engagement begins in Scoping, and it continues throughout Formulation, Deciding, and Implementation. The International Association for Public Participation (IAP2) identified five levels across a spectrum of public participation as seen in Table 12.1.

Table 12.1: IAPP's Public Participation Spectrum

INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
To provide the public with balanced, objective information to assist them in understanding the problem, alternatives, opportunities, and/or solutions.	To obtain feedback on analyses, alternatives, and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision, including the development of alternatives and the identification of the preferred solution.	To place final decision-making in the hands of the public.

Figure 12.1 shows where these different levels of involvement are most likely to occur in the planning process. Informing and consulting with the stakeholder are essential elements throughout planning. Providing information and seeking feedback are essential at the outset of a planning study and at each point where decisions are made, especially during formulation and screening decisions. Collaboration is going to be most important during Formulation and Deciding. Empowerment comes into play during the Implementation stage of the study.

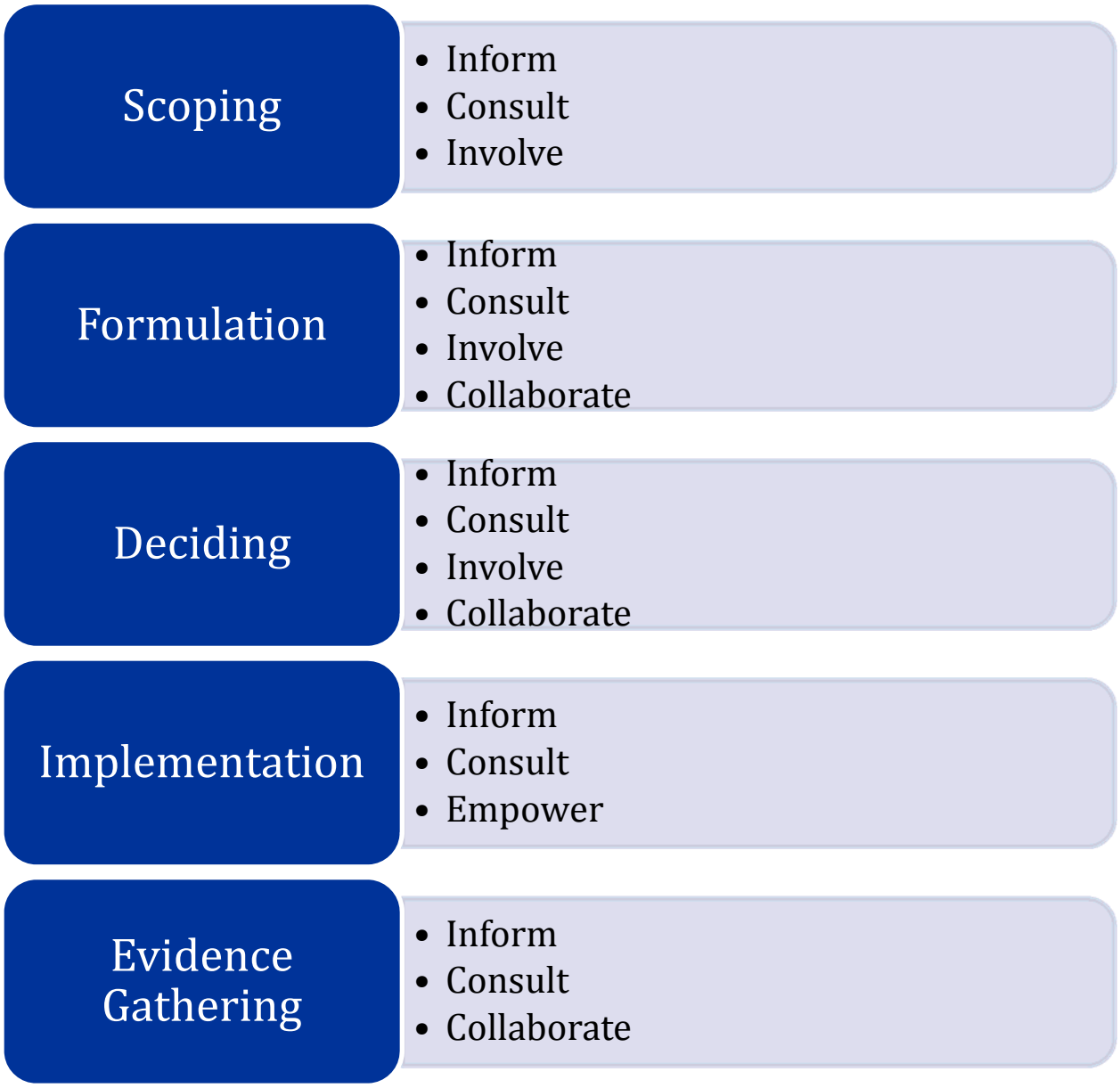

Figure 12.1: Public participation levels throughout the planning process

The IAPP identifies the seven *core values* of stakeholder participation, as shown below.

1. Public participation is based on the belief that those who are affected by a decision have a right to be involved in the decision-making process.
2. Public participation includes the promise that the public's contribution will influence the decision.
3. Public participation promotes sustainable decisions by recognizing and communicating the needs and interests of all participants, including decision makers.

4. Public participation seeks out and facilitates the involvement of those potentially affected by or interested in a decision.
5. Public participation seeks input from participants in designing how they participate.
6. Public participation provides participants with the information they need to participate in a meaningful way.
7. Public participation communicates to participants how their input affected the decision.

These ought to be the core values of a USACE public involvement program as well.

Creighton (2005) identifies the benefits of public participation as:

- Improved quality of decisions
- Minimizing cost and delay
- Consensus building
- Increased ease of implementation
- Avoiding worst-case confrontations
- Maintaining credibility and legitimacy
- Anticipating public concerns and attitudes
- Developing civil society

Despite these compelling values, USACE retains decision-making authority. Creighton (2005) identifies six reasons for this common occurrence.

- Agencies often are limited by mandates and authorities that constrain what they can do.
- Agencies are often implementing laws.
- The agency may be required to meet contractual obligations.
- Public consensus may not balance the needs of everyone affected by a decision.
- The public may simply disagree over what ought to be done.
- Those who participate in the process are more likely to be representing their self-interest than the public interest.

To varying extents, all of these reasons contribute to USACE's final decision authority in choosing a plan.

The goal of involving those people most likely to be affected by flood risk decisions will require involving segments of society that have been particularly difficult to involve in the past. This will require proactive efforts to engage these participants, continuing research on effective methods of engagement and may require programs to build capacity in these communities to participate effectively.

Source: Creighton, et al., 2009

A good public involvement process is cooperative, consultative, and collaborative; it provides the various participating stakeholders and publics with meaningful and timely opportunities to participate in the planning process. The public involvement process should be tailored to the study and the needs of its specific publics and stakeholders, including decision makers. A plan for involving the public should be prepared at the outset of every planning investigation. The USACE must then provide sufficient time, resources, and expertise to meet the commitments of that plan. According to Creighton, et al., (2009) that plan should:

- Provide the various publics with adequate opportunities for input as well as feedback
- Satisfy participants that the public involvement program is *responsive to their needs; that their information, viewpoints, and concerns have been adequately represented and taken into account; that they have been adequately consulted; and that their participation has been able to affect the way risk problems are defined and understood*
- Provide *sufficiently broad participation to ensure that the important, decision-relevant information enters the process, that all important perspectives are considered, and that the parties' legitimate concerns about inclusiveness and openness are met*
- Ensure that all stakeholders, including minority, low income, and tribal communities, have meaningful and informed participation in all aspects of decision-making that could affect the community
- Engage interested and affected parties during all phases of decision-making, including:
  - Identifying the problem
  - Forming objectives
  - Identifying alternatives
  - Evaluating alternatives
  - Identifying the preferred course of action
- Understand what risk questions and issues are of concern to non-federal decision makers and other interested and affected parties.

12.3 Partners and Stakeholders

A planning partnership is an arrangement where USACE and its partners formally agree to cooperate to advance their mutual interests. Your planning partners are generally the non-federal sponsors of a USACE planning activity. Stakeholders are any groups or individuals who can affect or are affected by your planning process and its outcomes. The public is anyone not on the PDT, so it is the most encompassing term that is parsed here for the convenience of understanding the special roles of some members of the public. One of the first public involvement actions the PDT needs to take is to identify the stakeholders.

12.3.1 Identify Stakeholders

A 2008 National Research Council (NRC) report defines four levels of *public*:

- *Stakeholders* – organized groups that are or will be affected by or that have a strong interest in the outcome of a decision
- *Directly affected public* – individuals and non-organized groups that will experience positive or negative effects from the outcome

- *Observing public* – the media, cultural elites, and opinion leaders who may comment on the issue or influence public opinion
- *General public* – all individuals who are not directly affected by the issue but may be a part of public opinion on it

Creighton et al. (2009) suggest there is an additional category of public with USACE decisions. This would be *Collaborating entities,* and it includes local sponsors and environmental regulators, as well as other federal, state, or local agencies or districts that are effectively partners in decision-making. The levels of involvement for these participants are shown in Table 11.2.

Table 12.2: Levels of involvement needed by each member of the *public* (Creighton et al. 2009)

TYPE OF PARTICIPANT	LEVEL OF INVOLVEMENT
Collaborating Entities	In effect, these parties are partners in the decision. USACE needs to offer sufficient opportunities for involvement to develop a high level of agreement on the tolerable level of risk and the proposed course of action.
Stakeholders *Directly Affected Public*	USACE must provide opportunities for high levels of interaction and mutual problem solving with these parties sufficient to get either agreement, or at least informed consent, on the tolerable level of risk, understanding of potential alternatives, and proposed course of action.
Observing public	Must believe they have had sufficient opportunities to comment on alternatives before decisions are made and must be fully informed about residual risks associated with the alternatives. They must be convinced that the proposed course of action is at least a reasonable course of action and better than doing nothing.
General public	Must be aware of their opportunities to participate and must be fully informed about costs, benefits, and residual risks associated with the alternatives and the course of action selected.

12.3.2 Prioritize Stakeholders

Brainstorming your stakeholders could produce a long list of people and organizations that could be affected by your study. It is best to know who on this list can help you or hurt you. The interest/power matrix (Thompson undated) of Figure 12.2 is an effective tool for doing this.

Consider these questions to help you identify stakeholders:

- Whose opinions will matter?
- Who is likely to support your efforts?
- Who is likely to object or put up obstacles?
- Who can make you fail?
- Whose support is necessary for success?
- Who is not playing but should be?
- Who can help you gather necessary evidence?
- With whom should you be communicating on a regular basis?
- Who has expressed an interest in this issue or issues like this in the past?
- Who will be affected by the solution?
- With whom will you consult before you make decisions?
- Who can influence the decision but is not directly involved with it?
- What external groups or organizations are affected by the change? Are there specific contact people?
- What people are interested in the success or failure of the plan?
- Who will support the study?
- Who might be opposed to the study?
- Are there political, environmental, or social consequences of the solution?

Adapted from: Mind Tools Limited, 2007

The PDT must pay the most attention to stakeholders with high power and high interest in a study. This may offend your sense of social justice, but it remains a simple fact. The Chief of Engineers will have high interest and power. Your significant other may have high interest and no power. Fully engage stakeholders with both high interest and high power, the county sponsor, and the EPA in the figure. Less interested but powerful stakeholders, like the governor and State Department of Natural Resources, should be kept satisfied, but do not engage them so much that you annoy them.

Low power, high interest people can often be helpful in evidence-gathering efforts. Keep these people well-informed. Communicate regularly with them and take care to ensure all their major issues are being addressed. People with low levels of interest and power should not be ignored. Monitor their interest. Address their concerns but do not bore them with too much communication.

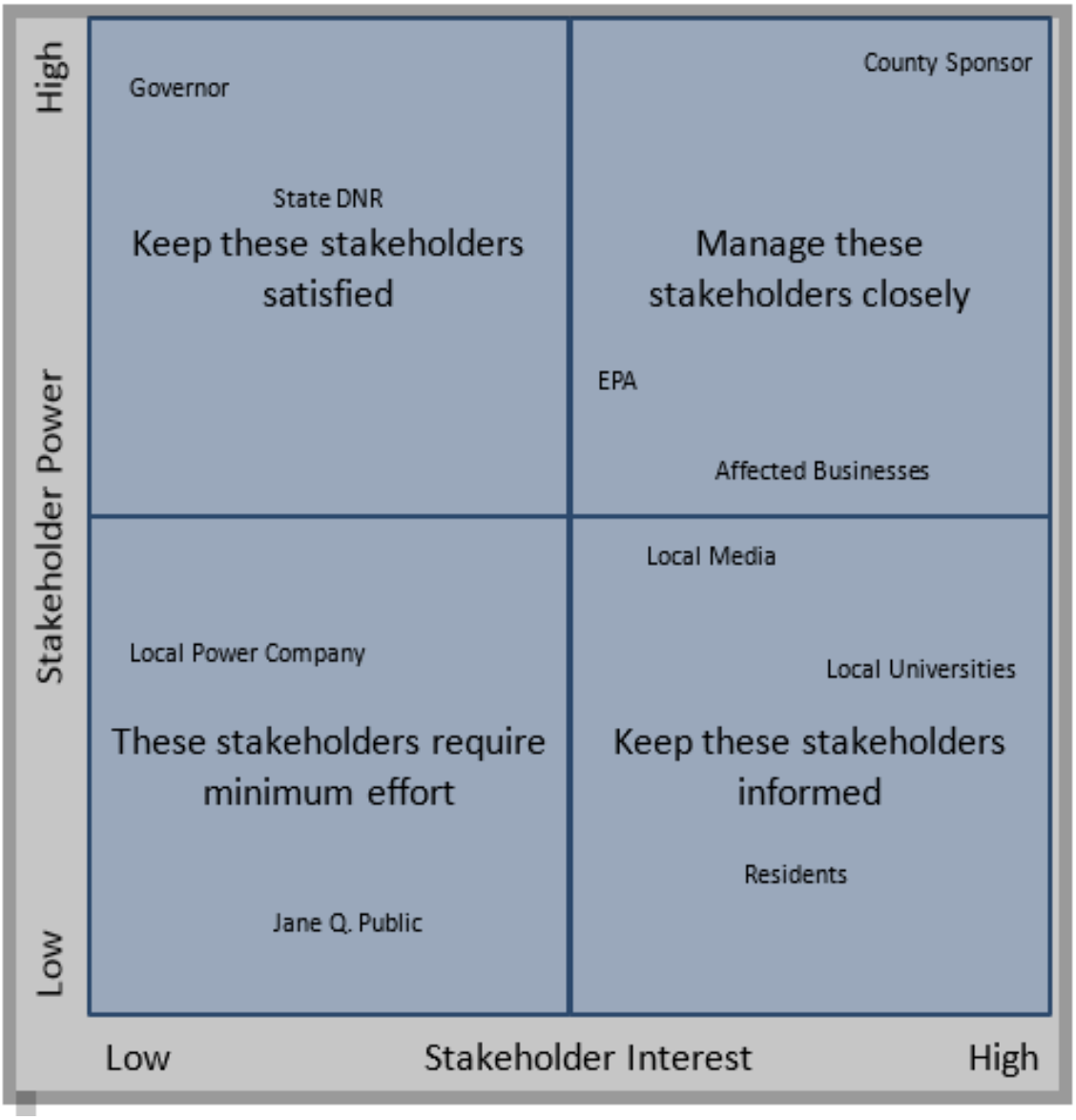

Figure 12.2: A stylized interest/power matrix with stakeholder groups mapped to the matrix (From Thompson, Rachel. 1996-2015. Stakeholder analysis winning support for your projects. Mind Tools. Accessed January 4, 2016 from https://www.mindtools.com/pages/article/newPPM_07.htm ©Mind Tools Ltd. 1996-2012. All rights reserved. With permission)

12.4 Involving Stakeholders

There are many techniques available for involving stakeholders, and with technology, they continue to grow. Table 12.3 presents examples of four categories of traditional and digitally based communication methods that can be used in addition to the traditional face-to-face conversation in an informal setting and regular telephone communication.

Table 12.3: Public participation communication methods – traditional and digitally based

Getting Information TO People		Getting Information FROM People	
Traditional	**Internet/Digital**	**Traditional**	**Internet/Digital**
Briefings	CDs and DVDs	Advisory group	Blogs
Brochures	Chatrooms	Charrette	Bulletin boards
Distribution lists	Computer simulation	Coffee Klatch	Chatrooms
Documents	Discussion boards	Consensus building	Discussion boards
Exhibits and displays	Distance learning	Contests	FAQ and Q&As
Fact sheets	Downloads – data, models, reports	Electronic town meeting	Groups on social networking websites
Feature stories	Electronic newsletters	Field trip	Interactive websites
Forums	Emails, text messages, and SMS blasts	Focus group	Listserv
Interviews	Facebook	Hotlines	RSS feeds
Logo items (e.g., mugs, thumb drives, fans)	Games	Instant voting (clickers)	Role playing
Mailings	Hotlines	Interviews	Social media
Media interviews	Interactive media	Meetings	Shared spaces
Media kits	Instant messaging	Negotiation and mediation	Site visits
Meetings	Multimedia resources	Public hearings	Surveys, polls, questionnaires
News conferences	Online advertising	Shared vision planning	Texting
Newsletters	Online videos and simulations		User data analysis
Newspaper inserts and advertisements	PDF-formatted documents		Virtual communication
			Wiki spaces
News releases	PowerPoint presentations		Web conferencing
Panels	Project website		
Presentations	Podcasts		
PSAs	Social media		
Repositories	Twitter		
Round table discussions	Videos		
Symposia	Visualizations		
Visitor centers	Webcasts		
Workshops	Webinars		

Feel free to innovate and try new ways to communicate throughout the life of a study.

12.5 When to Involve Stakeholders

The commitment to stakeholder engagement must be present from day one of the study. It cannot be an add-on, an afterthought, a series of events, or part of a grand check-off list; held a public meeting, check! It is an essential part of the entire planning process. Table 12.4 suggests some recurring and predictable points of stakeholder input and feedback in the planning steps. Each study is likely to have its own unique stakeholder engagement opportunities and, depending on its decision context, the stakeholders and their levels of interest.

Table 12.4: Points of input and feedback for public involvement in the planning process

Input opportunities	Feedback opportunities
Scoping	
Help identify problems and opportunities	Confirm problems and opportunities
Help identify planning objectives and constraints	Vet planning objectives and constraints
Help identify decision criteria	Vet decision criteria
Provide input to without condition scenario	Vet without condition scenario
	Vet public involvement process plan and stakeholder roles
Formulation	
Source of solution ideas – measures and plans	React to proposed solutions
Source of community needs, concerns, and values	
Deciding	
Identify candidate evaluation criteria	React to likely effects – beneficial and adverse
	React to solutions eliminated and retained
May provide insight into important trade-offs	React to differences and trade-offs among solutions
Implementation	
May provide weights for decision criteria trade-offs	Keep informed about study progress
May identify preferred solution	React to decision
May make final decision	

12.6 Risk

How does stakeholder engagement change in risk-informed planning? Planners must communicate effectively about risks with all stakeholders. Risk management requires risk communication as an essential element of stakeholder engagement. Considering decision-making in risk-informed planning, a 1996 NRC panel identified the essentials for effective risk decision-making as:

- Getting the science right – the analysis meets high scientific standards in terms of measurement, analytic methods, databases used, plausibility of assumptions, and respectfulness for both the magnitude and character of uncertainty, taking into consideration limitations that may have been placed on the analysis because of the level of effort judged appropriate for informing the decision
- Getting the right science – addressing the risk questions of greatest significance to stakeholders and decision makers and establishing priorities to ensure consideration of the issues most relevant to decision-making
- Getting the participation right – sufficiently broad participation to ensure that the important, decision-relevant information enters the process, all important perspectives have been considered, and the parties' legitimate concerns about inclusiveness and openness have been met
- Getting the right participation – decision makers and interested parties believe that the process has met their needs; their information, viewpoints, and concerns have been

adequately taken into account; they have been adequately consulted; and their participation has been able to affect the way the risk problem was defined and understood

- Developing an accurate, balanced, and informative synthesis – the risk characterization accurately reflects the range of knowledge and perspectives about the risk and satisfies the parties to the decision that they have been adequately informed within the limits of available knowledge.

The NRC panel points out that the process needed to characterize a risk is not the same process needed for broader stakeholder participation. The risk characterization process may be part of normal interagency consultation rather than a public forum. Other times, the PDT will need to characterize risks for non-expert audiences. The process is essentially the same, but the words and aids to understanding may need to be significantly different because risks are a social phenomenon as well as a physical one, and risk characterization must address the emotional and other social responses to risk. See the *Risk Manual* (Yoe 2017) for a detailed discussion of risk communication.

Residual risk is an especially important topic for risk communication and stakeholder engagement. Residual risk is the public's remaining risk exposure after a proposed plan is implemented. Ensuring that the community remains informed of residual risk after construction will require a continuous program of education once construction is completed (Creighton et al. 2009). Thus, it is critically important to recognize that risk communication is an ongoing responsibility throughout a project's life cycle.

12.6.1 Risk Communication

Many issues affect our ability to communicate about risk. Covello (1989) has identified a dozen factors that complicate risk communication that are worth understanding:

1. Risk is an intangible concept that the public does not understand – as a result, their risk taking or risk managing decisions can be based on bad information.

2. The public likes simple solutions – they are more likely to act effectively when the action is simple and are less likely to take effective action if the solution is more complex.

3. The public, including the media, does not like uncertainty or probability – they prefer concrete facts upon which to base their decisions and are prone to drawing inappropriate conclusions from uncertain and probabilistic information.

4. The public can react unfavorably to fear.

5. People are averse to losing control over their personal well-being; risks perceived as beyond the control of the individual present a special challenge for message development.

6. The public sometimes doubts scientific predictions – Y2K disasters and avian flu epidemics that did not materialize have taught people that scientists and experts can be wrong.

7. The risk at issue may simply not be one of the public's priorities – feelings of invincibility among the young render some risk messages ineffective because they cannot imagine their susceptibility to the risk.
8. The public tends to underestimate their personal risk – bad things happen to other people.
9. The public holds contradictory beliefs – I am not going to get cancer/everything causes cancer.
10. A majority of Americans lack a strong future orientation – live for today and let tomorrow take care of itself is a common perspective on the future. The future is less relevant to those in the lower socioeconomic strata of society.
11. The public tends to personalize new information – people have to translate risks described at societal or aggregated levels above the individual into terms that are personal. This invites opportunities for misinterpretation.
12. The public does not understand science – many people are poorly equipped to understand scientific messages because models, methodologies, and descriptions of risk can be too technical.

Armed with an awareness of these factors that complicate risk communication, careful risk message development becomes an indispensable skill for a risk analysis organization.

12.7 Communicating Uncertainty

Everybody wants you to sound certain. When you are not, you must have the courage to proclaim the uncertainty. Risk-informed planning differs from previous planning methods primarily in the intentional ways it addresses uncertainty throughout the planning process. If the planning process has succeeded in being intentional about uncertainty, then stakeholder engagement has a duty to proclaim that uncertainty to stakeholders. Speaking about uncertainty presents special challenges to the PDT.

> Overconfident false alarms can cause lost credibility and considerable derision. Overconfident false reassurances can cause lost lives and a devastated reputation. The choice between these two should be easy.

Explaining technical information to the public is part of the risk communication challenge. Peter Sandman, in a number of publications, identifies four things to remember when explaining uncertainty to the public:

1. Motivation
2. Simplification
3. Orientation
4. Proclaim uncertainty

12.7.1 Motivation

Learn to motivate people to want to hear the more technical information. When people are upset or outraged, your careful analysis and numbers do not help or hurt their ability to understand the risk. How you explain data is irrelevant because outraged people do not want to hear or believe the data. Your first job is to address and reduce their outrage. Figuratively, that means talking them down from the window ledge. Then you have a chance to make people want to hear your numbers. Do this by sharing power with them. Give them a decision to make with the information you have and then they may care about your numbers. It will help you to ask what people are interested in and want to know. If the numbers help fill those gaps then people will care.

12.7.2 Simplification

When broaching technical subjects, simplification is important. Simplify your language, graphics, and content. Simplify language by cutting out words used to impress people with your technical expertise. Do not use acronyms and omit jargon, especially when tension is high. They create barriers between you and your audience. If you must use jargon, introduce the concept before the word. Tell people to stop you if you lapse into jargon they do not understand. If you are going to use a word you must define first, just use the definition.

Earlier in this manual, you were told to show the data and use multivariate relationships in your graphs. That is true for decision makers; however, when dealing with the public, it is time to simplify graphics. Use bar graphs and pie charts when you can. Put only one point on a graphic and include the conclusion right on the graphic. When you must introduce complex information, animate it to simplify it as much as possible.

Keep the content simple by sticking to your main points. Only include details that are needed to explain the main points or that are needed to avoid losing credibility later. Do not skimp on non-technical details like the issue history, politics, and contextual information the audience already knows. Tell stories or at least use concrete language. Personalize the message and do not be afraid to be a three-dimensional person to the audience. Remember to check for nonverbal cues to gage how well people are understanding the message. Repeat content the audience struggles to understand.

12.7.3 Orientation

Tell people where you are in your explanation and tell them where you are going. Remind people of the structure of your discussion so they can gage your progress.

To keep people oriented, help them develop the right attitude about the risk and the uncertainty. Take special care not to give people too much guidance on what to think or feel, avoid saying things like, *If I were you, I would not worry about it*. Likewise, do not get too technical or distant, leave the audience free to understand the data and draw the conclusions they want to draw. Test your technical

Learn to Say Things Like…

We will name 4 things, examine 3 reasons, and look at 5 causes.

We're rather uncertain now but soon will have answers and will know more.

We're extremely uncertain and will stay extremely uncertain for a long time.

We have answers and will know more.

We're extremely uncertain and will stay extremely uncertain for a long time.

explanations before using them on the public if you can. Let your friends or children listen to them and critique you. When you explain technical material, use inductive reasoning; that means, give people the conclusions first, then the reasons for them. Distinguish major points from minor points for your audience.

Confidence Limits Help People Think about Uncertainty

Learn to Say…

Here is what we know for sure…

Here is what we think is almost, but not quite, certain…

Here is what we think is probable…

Here is what we think is a toss-up…

Here is what we think is possible but unlikely…

Here is what we think is almost inconceivable…

Acknowledge the existence of people's preconceptions, especially if you are going to conflict with them. I know most of you think that levee is sound, but our investigations have found some problems you need to know about. Learn to use *confidence limits* not so much in the statistical sense but in your language (see textbox). Keep people oriented by using more reasoning and less evidence (i.e., use words not numbers). Make use of non-technical aids like examples, anecdotes, quotations, and comparisons.

12.7.4 Proclaim Uncertainty

Perhaps one of the best ways to proclaim uncertainty is to never sound more certain than you are. Take care not to say more than you know. Tell people what you know with certainty, then tell them what you wish you knew but do not. Do not wait to be confronted; acknowledge your uncertainty up front. Help the audience by putting bounds on the uncertainty and clarify that you are more certain about some things than others. Report everybody's estimates, especially if they conflict with your own.

Explain what you have done or are doing to reduce the uncertainty. If the remaining uncertainty is very small or very difficult to reduce further, say so. Let people know when you will not be doing any more to reduce the uncertainty. Stress that finding out for sure may be less important than taking appropriate precautions now. Do not hide behind uncertainty or use it as an excuse of any kind and acknowledge that people can and do disagree about what to do in the face of uncertainty.

Take special pains not to ever say "there is no evidence of X" when you have not done the study that tests for the possibility of X. So do not say there is no evidence of piping in a levee, unless you have carefully looked for it.

Speak plainly to people in ways that are meaningful and understandable. Some early draft guidance for the national levee safety program said, "Refrain from using words such as *failure* when referring to a breach." When a levee breaches, the public sees a failure. Have the courage to speak plainly and directly. Call a breach a failure, everyone else is.

Can you see yourself telling people protected by a levee the importance of evacuation by saying, *If you do not leave, you place yourself and your family at risk of death by drowning, heat exhaustion or hypothermia, starvation, injury, illness and misadventure?* If you cannot, you may not understand uncertainty or risk.

Be willing to scare people; then learn how to scare people. We cannot prepare adequately for every possible disaster, and the public needs to know that. In flood risk management, we need to say even with this plan in place, your families, homes, and communities are still at risk, and you must be prepared.

This levee might not function as we want it to. Breaches, or openings in the levee, could occur during floods, causing it to fail to provide protection. A flood so deep it flows over the levee could occur. The resulting damage, displacement, and hardship to you and this community would be devastating. Recovery would take a long time. The devastating risk we are talking about is neither likely nor impossible, but we must be prepared for it.

Preparedness is a partnership. It includes the federal government, which may build the project; the state government, which may share in its costs; the local government, which may operate and maintain it and develop an evacuation plan; and individuals who still should buy flood insurance, evacuate promptly when told to, and perhaps build an escape hatch from their upper floor to their roof.

In order to build a constituency for preparedness, you must be willing to paint scary pictures of unpreparedness. In a world of uncertainty, you must learn to frighten people just long enough to get them to decide what to do to prepare and then to do it. Do they need to raise money to fix a problem? Do they need to do real evacuation planning? If you want to make preparedness popular, you have to scare people.

Avoid over assurances if you want people to be prepared. If you say, we are ready or we will protect you, your message encourages complacency beforehand and recriminations afterward. There will always be residual risk. If we are to manage it as well, we cannot allow the community to imagine that we have done enough by building a levee. Communities need to discuss and debate how to handle residual risks of flooding and storm damage in particular. Individuals must recognize that we can never be completely prepared for everything, no matter how much we spend. That may mean we will sometimes guess wrong and end up preparing for the disaster that did not happen instead of the one that does. That may be a safer mistake to make than not preparing for the disaster that does occur.

Often, a plan may leave a community facing a low probability of a high consequence. The low probability tells us do not worry about it. The high consequence tells us to take precaution. The two together can produce a sense of ambivalence about the residual risk. Given a choice, as planners in an uncertain environment, between under reacting and over reacting, taking precautions that will probably not be needed is often the wisest response.

Planners need the courage to talk when uncertain. Do not wait too long. Many of the most important, actionable risk communication messages are uncertain messages. Warn the community. If you say things that increase outrage about a risky situation, you raise awareness of the hazard. This increased hazard perception can increase the community's willingness to take or accept precautions. If, by contrast, your messages are of reassurance, you will likely decrease outrage about the risky situation, and this will lead to

How Do You Effectively Communicate Flood Risks?

Principle #1—Communicate in Multiple Ways

Principle #2—Understand How High Stress Changes the Rules!

Principle #3—Probability Plus Values Equals Real Risk

Principle #4—Recognize and Address Audience Fear and Anger

Principle #5—Acknowledge Uncertainty

Principle #6—Explain Complex and Technical Information

Principle #7—Anticipate, Prepare, and Practice for Media Interaction Source: Tinker and Galloway 2008

Technical Information

Principle #7—Anticipate, Prepare, and Practice for Media Interaction

Source: Tinker and Galloway 2008

decreased perception of the hazard, which is likely to decrease the community's willingness to take or accept precautions.

12.8 Five Points to Take Away

Here are five key points to take away from this chapter.

1. Stakeholder involvement produces better decisions that are supported by the public
2. Different levels of engagement are needed for different types of stakeholders, from inform to consult to involve to collaborate to empower.
3. Stakeholder engagement is incorporated throughout the study process; it is not an add-on or check-off activity.
4. Communicating about risk, especially residual risk, introduces a special challenge to stakeholder engagement.
5. Explaining technical information to the general public requires motivation, simplification, orientation, and proclaiming uncertainty.

12.9 References

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Institute for Water Resources

The Institute for Water Resources (IWR) is a U.S. Army Corps of Engineers (USACE) Field Operating Activity located within the Washington DC National Capital Region (NCR), in Alexandria, VA with satellite centers in New Orleans, LA; Davis, CA; Denver, CO; and Pittsburgh, PA. IWR was created in 1969 to analyze and anticipate changing water resources management conditions, and to develop planning methods and analytical tools to address economic, social, institutional, and environmental needs in water resources planning and policy. Since its inception, IWR has been a leader in the development of strategies and tools for planning and executing the USACE water resources planning and water management programs.

IWR strives to improve the performance of the USACE water resources program by examining water resources problems and offering practical solutions through a wide variety of technology transfer mechanisms. In addition to hosting and leading USACE participation in national forums, these include the production of white papers, reports, workshops, training courses, guidance and manuals of practice; the development of new planning, socio-economic, and risk-based decision-support methodologies, improved hydrologic engineering methods and software tools; and the management of national waterborne commerce statistics and other Civil Works information systems. IWR serves as the USACE expertise center for integrated water resources planning and management; hydrologic engineering; collaborative planning and environmental conflict resolution; and waterborne commerce data and marine transportation systems.

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Other enterprise centers at the Institute's NCR office include the International Center for Integrated Water Resources Management (ICIWaRM), under the auspices of UNESCO, which is a distributed, intergovernmental center established in partnership with various Universities and non-Government organizations; and the Conflict Resolution and Public Participation Center of Expertise, which includes a focus on both the processes associated with conflict resolution and the integration of public participation techniques with decision support and technical modeling. The Institute plays a prominent role within a number of the USACE technical Communities of Practice (CoP), including the Economics CoP. The Corps Chief Economist is resident at the Institute, along with a critical mass of economists, sociologists and geographers specializing in water and natural resources investment decision support analysis and multi-criteria tradeoff techniques.

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